United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

Pest Risk Management
For Chinese Penjing Plants

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Pest Risk Mitigation Measures

A. Introduction

The risks associated with the importation of penjing (landscape bonsai) plants from the People's Republic of China without specified growing, inspection, and certification requirements were analyzed in the associated plant pest risk assessment documents (USDA, 2003a; 2003b; 2003c; 2003d; 2003e). These assessments identified forty-eight pests for which the pest risk potential is high enough to warrant additional risk mitigations.

The proposed importation of penjing plants in APHIS-approved growing media and under specified growing conditions, if approved, will be managed by existing regulations [7 CFR § 319.37-5 (q) and 319.37-8 (e)] supplemented with new regulations specific to mitigating the pest risk posed by penjing plants from China. As required by these regulations, the National Plant Protection Organization of China must enter into a written agreement or bilateral workplan with APHIS for enforcement of these regulations including entering into a written agreement with the growers where the grower agrees to comply with the growing conditions and any other requirement specified in the regulations. The mitigation measures described in 7 CFR § 319.37-8 comprise a "Systems Approach" designed to establish and maintain a pest-free production environment while 319.37-5 is specifically designed to prevent the introduction of wood-boring insects in artificially dwarfed plants. The Plant Protection Act of 2000 (7 USC §§ 7701 *et seq*.) defines a "Systems Approach" as "…a defined set of phytosanitary procedures, at least two of which have an independent effect in mitigating pest risk associated with the movement of commodities" (7 USC § 7702). The Food and Agriculture Organization of the United Nations (FAO) definition of a Systems Approach is, "The integration of different pest risk management measures, at least two of which act independently, and which cumulatively achieve the desired level of phytosanitary protection" (FAO, 2002). Pest risk management is one of the components, along with risk assessment and risk communication, of the decision-making process for reducing the risk of introduction of quarantine pests (FAO, 2002). These mitigations effectively remove the pests from the pathway prior to importation into the United States.

Systems Approaches are established by an importing country as an alternative to the use of single quarantine measures when a single phytosanitary measure is nonexistent, not feasible or undesirable. The combination of specific mitigation measures that provide overlapping or sequential safeguards is distinctly different from single mitigation methodologies such as fumigation or inspection (Jang and Moffitt, 1994). Systems Approaches vary in complexity and are often tailored to specific commodity-pest-origin combinations (FAO, 2002). Options for specific measures may be selected from a range of production and post-production measures (*e.g*., surveys, inspections, sanitation, chemical treatments, etc.) and include mitigation measures to compensate for uncertainty. USDA uses systems approaches for the importation of many commodities including Unshu oranges from Japan (7 CFR § 319.28), tomatoes from Spain, France, Morocco, and Western Sahara (7 CFR § 319.56-2dd), peppers from Israel (7 CFR § 319.56-2u), fruit tree nursery stock from Europe (7 CFR § 319.37-5) and ferns from the Netherlands (7 CFR § 319.37-8). These programs performed successfully for many years (NPB, 2002; Miller, 2003) and continue to be effective as evidenced by the very low numbers of interceptions (PIN309, 2003; NPB, 2002; Miller, 2003).

The three main categories of mitigation measures specifically required by 7 CFR § 319.37-8 (e) for *Buxus sinica, Ehretia microphylla, Podocarpus macrophyllus, Sageretia thea* and *Serissa foetida* plants from China are: use of pest-free propagative material, pest-exclusionary greenhouses and inspection. Ensuring pest-free propagative material requires monitoring and testing of mother stock and descendant plants (Agrios, 1997; Jarvis, 1992; Kahn, 1977) to ensure that they are pest-free.

To exclude pests, greenhouse managers employ pesticide treatments, good sanitation, *e.g.,* surface disinfection of tools and plant materials, *etc*. (Agrios, 1997; Bessin, 2001; Jarvis, 1992; Roosjen, *et al*., 1999), clean water sources (Bodman *et al*., 1996; Jarvis, 1992; Roosjen *et al.*, 1999; Van der Plank, 1963), effective barriers (screens and automatic doors) (Bethke *et al.*, 1994), approved growing media and pesticide treatments (NEGFG, 2003). Sanitation is the general cleanliness and pathogen-free condition of the nursery operation, aimed at reducing the overall inoculum level in the nursery (Jones and Benson, 2001). Improper nursery practices are the primary means by which pathogens are introduced and spread in the nursery (Jones and Benson, 2001). These problems are avoided by oversight and quality assurance required by USDA APHIS as formalized and captured in a bilateral workplan.

Phytosanitary Implications of Common Production Practices

While not specifically required under 7 CFR § 319.37-8(e), common industry practices further ensure that the pests of concern do not follow the pathway. These practices include sanitation and chemical treatments designed to reduce or eliminate insects (Bessin, 2001; Mizell and Short, 1998) and fungi (Jones and Benson, 2001), and *in vitro* or aseptic vegetative propagation (Hartman and Kester, 1959). Other cultural practices, such as proper lighting, fertilization, sanitation, temperature and watering, enhance plant vigor, thereby reducing susceptibility to some pests such that pests are less able to infest or infect mother stock (Bodman *et al*., 1996; Jones and Benson, 2001; Roosjen, *et al*., 1999).

Well water is the preferred source for irrigation, since it is generally pathogen-free, while untreated pond or river water may carry disease organisms or pesticides (Rideout *et al*., 1994). Other sources, such as potable municipal water or boiled water are also expected to be pathogen-free, although they may be more costly for the grower.

Pest management of ornamentals often includes chemical pest control (Osborne, *et al*., 2001). Chemical controls are supplemental and used in combination with other mitigation measures, such as pest exclusionary greenhouses (Reinert, 1981; Ghidiu and Roberts, 2003).
Pest management of ornamentals often includes use of chemical control of pest populations (Osborne, *et al*., 2001).

Physical pest control measures are effective mitigations in greenhouses. Such measures include washing with a hose and water and spraying inert soap sprays for aphids; spraying with horticultural oils for mealybugs, scale insects, and whiteflies; and physical removal and destruction for leafminers.

Spray programs can vary widely; for instance, whitefly infestations must be treated every four to six days for control while other pests may be effectively controlled with a two–week interval between sprays (BSF, 1998).

B. Program Requirements for Plants in Growing Media and Artificially Dwarfed Plants

Risk mitigation measures proposed for the artificially dwarfed *Buxus sinica, Ehretia microphylla, Podocarpus macrophyllus, Sageretia thea* and *Serissa foetida* penjing plants from the People's Republic of China are derived, in part, from the risk mitigation program requirements outlined in the USDA regulation for certain plants in growing media [7 CFR § 319.37-8(e)] which requires that plants be accompanied by a phytosanitary certificate signed by the plant protection service of the country of origin indicating that the plants meet the following conditions:

(1) Plants must be established in approved unused growing media, which is defined in 319.37-8(e)(1).

(2) Articles must be grown in compliance with a written agreement for enforcement of this section signed by the plant protection service of the country of origin and Plant Protection and Quarantine (PPQ), APHIS. The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. The inspection will be performed by an APHIS inspector or an inspector of the plant protection service of the country of origin.

(3) The plants must be grown in compliance with a written agreement between the grower and the plant protection service of the country of origin. The grower must allow access to his facility to make sure it complies with the regulations.

(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests and disease. The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6mm. All entryways must be equipped with automatically closing doors.

(5) Plants must be rooted and grown in an active foliar state for at least four consecutive months before export. The greenhouse must be used solely for plants grown in compliance with 7 CFR § 319.37-8.

(6) Plants must be grown from seeds germinated in the greenhouse or descended from a mother plant that was grown for at least nine months in the exporting country. If the mother plant was imported into the exporting country, then it must be grown for at least twelve months prior to establishment of the descendent plants, or treated at the time of importation into the exporting country with a treatment for pests of the plant as prescribed by the plant protection service of the exporting country and then grown for nine months prior to establishment of descendent plants.

(7) Plants must be watered only with rainwater that has been boiled or pasteurized, with clean well water, or with potable water.

(8) Plants must be rooted and grown in approved growing media on benches supported by legs and raised at least 46cm above the floor.

(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.

(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases by an APHIS inspector or an inspector of the plant protection service of the country of origin.

In addition, if plants are over two years–old they would enter under the conditions specified in 7 CFR § 319.37-5q. This regulation was promulgated in September, 2002 to protect against the introduction of longhorned beetles (*Anoplophora* spp.) into the United States in artificially dwarfed plants. Under the conditions specified in 7 CFR § 319.37-5q, plants must spend at least two years in the greenhouse to mitigate against any infestation with longhorned beetles. The other conditions of 7 CFR § 319.37-5q are equivalent to provisions within 319.37-8 and the former regulation only applies to plants over two years old. Plants older than two years must be artificially dwarfed to enter; all other plants are subject to the size / age restrictions outlined in 7 CFR § 319.37-2(b).

C. Additional Requirements

As stated in Section A above, Systems Approaches vary in complexity and are often tailored to specific commodity-pest-origin combinations (FAO, 2002). To tailor the existing codified systems approach described in 7 CFR § 319.37-8 to mitigate the specific risks posed by penjing plants in growing media from China and in response to public comments, pest risk mitigation measures in addition to those described in Section B will be added. APHIS will add the following additional mitigation measures:

1. Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing only APHIS approved growing media. When plants (rooted or unrooted cuttings) are moved to the greenhouse, they must be washed free of planting media and debris and dipped in pesticide(s) to control mites, insects, fungi and nematodes.

2. Water source must comply with 319.37-8(e)(v): (see Section B (7) above) regardless of whether cuttings are established inside or outside the greenhouse.

3. Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with appropriate pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.

D. Work Plans, Quality Assurance and Program Safeguards to Ensure Compliance

As outlined above in Section B (Program Requirements for Plants in Growing Media and Artificially Dwarfed Plants), the plants in growing media regulation [7 CFR § 319.37-8(e)] and the artificially dwarfed plants regulation [7 CFR § 319.37-5(q)] mandate certain procedures by APHIS and the plant protection service of the country of origin to ensure compliance with the regulation. A written agreement between the plant protection service of the country of origin and APHIS outlines the respective responsibilities and obligations for the enforcement of the various requirements of 7 CFR § 319.37-8(e) and 7 CFR § 319.37-5(q). This agreement is called the "bilateral work plan". A current operational work plan for plants in growing media from the Netherlands is in use (see box below) and serves as a model for the proposed Penjing from China workplan. Before plants can be imported from the People's Republic of China, a work plan must be developed and signed. The bilateral work plan details how the program will be monitored and supervised to ensure compliance with regulations and the production of pest–free plants. Because the Chinese penjing program represents a different pest complex, in different hosts with different production practices it will necessarily differ in details from the Netherlands model shown below.

SUMMARY OF NETHERLANDS WORK PLAN 2003

This program is operated under agreement between the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) and Ministry of Agriculture, Nature Management and Fisheries Plantenziektenkundige Dienst (PD).

DEFINITIONS

A. PRODUCT BEING EXPORTED

Specific plant species allowed only in approved growing media (7CFR' 319.37e-1).

B. PEST AND/OR ORGANISMS OF CONCERN

C. PARTICIPATING ORGANIZATIONS

USDA REGULATIONS GOVERNING THE ENTRY OF PLANTS IN GROWING MEDIA INTO THE UNITED STATES

A. PLANTS IN GROWING MEDIA ARE REGULATED UNDER 7CFR319.37(Q37)-8(E)

1. Certain plants may be imported established in growing media if there is a written agreement with the Plant Protection and Quarantine Service of the country where the article is grown, and they agree to implement a program in compliance with the provision of subpart Q37-8(e).

2. There must be a written agreement between the grower and PD in which the grower agrees to comply with the provisions of the program.

3. Plants in growing media are also subject to inspection and other actions at the time of importation into the United States under regulations Q37-4 and Q37-8(e)(6).

4. A written permit from USDA Plant Protection and Quarantine (PPQ) is required for importation of plants in growing media in lots of 13 or more articles (other than seeds, bulbs, or sterile cultures of orchid plants) from the Netherlands.

B. CONDITIONS OF ENTRY

Each shipment must be accompanied by a Phytosanitary Certificate (PC) including an accurate Additional Declaration (AD) stating that the plants meet conditions of growing, storing, and shipping in compliance with Q37-8(e).

RESPONSIBILITIES

A. IT IS THE RESPONSIBILITY OF APHIS TO:

Set and provide the phytosanitary standards for the production of approved genera; review and provide input into the draft work plan ; verify that each participant properly carries out its responsibilities; monitor the system conducting inspections optimally once a quarter but not to exceed once a month

B. IT IS THE RESPONSIBILITY OF THE PD TO:

Commit to active participation in all activities; draft the work plan; enforce the provisions of the work plan; conduct monthly inspections of approved facilities, and the crops within; conduct the phytosanitary inspections; issue and sign the PC ; provide APHIS with a monthly accounting of the stocks of each of the genera of plants included in the program, from each grower; conduct biological testing for the presence of plant pests; advise growers of pest control procedures; provide APHIS annually with an updated list of authorized growers and exporters; add new growers or exporters to the authorized list; perform the inspection of any greenhouse units that approved growers wish to be added to the program; drop growers and/or exporters from the program.

C. IT IS THE RESPONSIBILITY OF THE GROWERS TO:

Abide by all requirements of the work plan and applicable regulations; be registered in the program and have a written agreement with the PD; maintain accurate records of all activities; formally request in writing to PD for inspection of new greenhouse units; formally request in writing to PD any voluntary withdrawal of facilities.

INSPECTION

A. LOCATION OF INSPECTIONS

Inspections are carried out at approved facilities/greenhouses.

PD ensures that the phytosanitary standards set by APHIS are maintained; is responsible for inspection during the growing season and during packing; included in inspection activities is biological testing for the presence of plant; will have the primary responsibility for advising its growers and exporters as to pest control procedures and practices.

APHIS shall be involved primarily in systems monitoring. Greenhouse monitoring inspections are conducted jointly by a team consisting of APHIS and PD inspectors. Any shortcomings found should be corrected promptly with subsequent confirmation by PD re-inspection..

Plants must be inspected in the greenhouse and found free from evidence of plant pests and diseases by a PD or an APHIS Officer no more than 30 days prior to the date of export to the United States.

B. SAFEGUARDS

1. Phytosanitary Standards are set by APHIS. They include, but are not limited to the requirements outlined in 7 CFR 319.37-8 (See above, Section B. Program Requirements for Plants in Growing Media and Artificially Dwarfed Plants).

2. Port of Entry Inspections: APHIS Officers at a Port of Entry verify paperwork to assure that the description of the shipment (number of boxes, labels, etc) agrees with the bill of lading, packing list, invoice, etc. and check that the PC contains the proper AD. Inspections are conducted at a USDA/PPQ Plant Inspection Station. All shipments are subject to cargo monitoring protocol as established by the USDA Agricultural Quarantine Inspection Monitoring Program.

VIOLATIONS/CORRECTIVE ACTIONS

A. PROCEDURES

1. First Warning (Action)

a. Plants that arrive in the United States without the correct AD on the PC will not be considered as been grown under Q37-8(e) guidelines and will be refused entry.
b. If the above occurs, the broker/importer/ shipper is given three options: destruction, treatment (*i.e.*, removal of the growing media from the roots) or return to country of origin.

2. Second Warning (Action)

a. Growers and/or exporters may be dropped from the Program on the basis of repetitive or gross violations of procedural or biological specifications

B. PROGRAM SUSPENSION/TERMINATION

1. PD may suspen d the Program if there are no facilities that meet APHIS standards.

2. APHIS may suspend the Program on the basis of repetitive or gross violations of procedural or biological specifications. This will be done formally by letter from APHIS.

C. PROGRAM REINSTATEMENT

1. If the Program is suspended for biological reasons, PD must provide details of proposed corrective actions.

2. APHIS must agree on reactivation.

PROGRAM REVIEW AND EVALUATION

The Area Director or other APHIS officials will make periodic visits to review the operations and consult with PD, foreign cooperators, and industry officials. During such visits, meetings may be held to discuss problems and issues of mutual concern. Procedures herein established are subject to revision as situations warrant; however they will remain in effect indefinitely until revised (appendices may be updated each season).

E. Historical Performance of Existing Plants in Growing Media Import Programs

Current quarantine regulations 7 CFR§319.37-8(e) allow plants of *Alstroemeria, Ananas, Anthurium, Begonia, Gloxinia, Peperomia,* certain ferns, rhododendrons from Europe and *Saintpaulia* to be imported into the United States in accordance with the measures described in Section B. These same measures will apply to artificially dwarfed penjing plants from China. In evaluating these risk management measures as they apply to penjing plants from China, APHIS reviewed (Miller, 2003) the performance record of the current program.

Summary of results of regular APHIS inspections of the greenhouses participating in the plants in growing media import program from 1990 to April 2003.

- In the Netherlands, three greenhouses currently participate in the program, although the number has ranged from two to four greenhouses. Both ferns and *Anthurium* are grown and exported to the United States. Currently, three greenhouses are in the program. APHIS plant health specialists inspected the greenhouses four to twelve times a year. They inspect for both noncompliance and plant pests. Plant pests were not found on any of these visits.
- In Israel, one greenhouse growing ferns and African violets participated in the program between 1990 and 1994. This facility was inspected by APHIS plant health specialists from three to five times a year. Again, plant pests were not found.

All totaled, APHIS plant health specialists made approximately 200 inspectional site visits to participating greenhouses. Plant pest detections were not made during any of these visits (Miller, 2003).

Additional greenhouse inspections.

In addition to the regular program inspections, on at least two different occasions participating greenhouses were visited by plant health specialists from the United States as part of general reviews of APHIS import programs.

In February 1984, two entomologists and a plant pathologist from PPQ inspected a program greenhouse in the Netherlands. Plant pests were not found.

In March 1990, the Officer-in-Charge of the Plant Inspection Station at John F. Kennedy International Airport, NY, also carefully inspected a program greenhouse in the Netherlands and found no plant pests (Miller, 2003).

Port of Entry Inspections

Only one port of entry inspectional detection was reported from program export plants. In 1990, a Lepidoptera larva was found in a single shipment. A very careful inspection of the originating greenhouse in the Netherlands failed to detect any pests and the interception was questioned (Miller, 2003). In contrast, there were numerous interceptions during port of entry inspections of bare-rooted plants that are not required to enter under the proposed rule for plants in growing media (PIN 309, 2003).

F. Evidence for the Effective Removal of Pests of Concern from the Pathway

Based on their characteristics, e.g., respective biologies, methods of dispersal and ability to be detected, APHIS concludes that the safeguards of 7 CFR§319.37-8(e), 7 CFR § 319.37-5(q) and the additional penjing-specific measures described above in Section C result in the effective removal of the pests of concern from the pathway identified by the risk assessments for the importation of *Buxus sinica, Ehretia microphylla, Podocarpus macrophyllus, Sageretia thea* and *Serissa foetida,* from the People's Republic of China (USDA, 2003a; 2003b; 2003c; 2003d; 2003e). The FAO (2002) defines "pathway" as "Any means that allows the entry or spread of a pest." The following paragraphs present the evidence APHIS used to determine that the measures required by 7 CFR§319.37-8(e), 7 CFR § 319.37-5(q) and the additional penjing-specific measures described above in Section C would effectively remove pests of concern from the penjing plants from China pathway. These additional measures were deemed necessary to achieve phytosanitary security for Chinese penjing plants that is equivalent to that for plants currently allowed entry under CFR§319.37-8(e). Specifically, that regulation currently permits the entry of certain plant species, for which a 0.6 mm mesh screen is sufficient to exclude pests of concerns. The plant pest risk assessments for Chinese penjing (USDA, 2003a; 2003b; 2003c; 2003d; 2003e) identified pests that may not be completely excluded by the 0.6 mm mesh screen requirement. It was also noted that standard industry practice involved rooting cuttings outside the greenhouse. Consequently, the required greenhouse growing period was extended to six months and the required frequency of pesticide applications was increased from every 30 days as described in the proposed rule on penjing from the People's Republic of China (APHIS, 2000) to every 10 days. In addition, to achieve equivalent phytosanitary security for outdoor rooted cuttings, APHIS requires the use of approved growing media, raised benches, root washing, pesticide dips and replacement of the growing media prior to entering the greenhouse (see sections 12 to 14 below).

Mitigation Measures

The following paragraphs summarize key mitigation measures of the Chinese penjing systems approach and provide a general discussion of their efficacy.

(1) Plants must be established in unused approved growing media.

Root disease assessment is more challenging than foliar disease assessment because the roots are "hidden" in the growing media, making them difficult to inspect. Therefore, root pest prevention is essential for excluding this type of quarantine pests. An important component of a systems approach to preventing such infection is to prevent pathogens from being introduced with the growing media (Hall, 1996). Fungal pathogens are often introduced into the greenhouse via soil particles, so the use of sterilized or pasteurized growing media is commonly recommended to prevent the introduction and/or spread or both of many fungal pathogens (Barry, 1996; Daughtrey, *et al*., 1995; McQuilken and

Hopkins, 2001). Studies on APHIS-approved growing media found that pathogens are not present (Palm, 1994; Santacroce, 1991).

(2) Articles must be grown in compliance with a written agreement for enforcement of this section signed by the plant protection service of the country of the country of origin and Plant Protection and Quarantine APHIS. The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. The inspection will be performed by an APHIS inspector or an inspector of the plant protection service of the country of origin.

As discussed earlier (Section E), written agreements between the exporting country and APHIS are effective tools for communicating and enforcing the phytosanitary measures necessary for ensuring a pest-free commodity. Enforcement is carried out primarily through inspections.

The use of clean mother stock is an essential component of ornamental plant production (Agrios, 1997; Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Roosjen *et al*., 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Fungal pathogens introduced into the greenhouse via infested plant material can also be reduced or eliminated by clean mother stock (Jones and Benson, 2001).

(3) The plants must be grown in compliance with a written agreement between the grower and the plant protection service of the country of origin. The grower must allow access to his facility to make sure it complies with the regulations.

Access helps to ensure compliance with APHIS requirements by providing a mechanism for removal from the program if pests are found (Kahn and Mathur, 1999).

(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests and disease. The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.

To exclude plant pests, the mesh size of the screen is critical (Byrne, 1998). Two recent publications give the mesh size of screen required to keep out certain pests, as shown in Table 1.

Table 1: Screen Hole Size (microns)[1] to Prevent Pest Entry.

	Ghidiu and Roberts, 2003	Ferguson and Murphy, 2000
Leafminers	640	608
Whiteflies	462	239
Aphids	340	355
flower thrips	192	215

[1]1 mm = 1,000 microns

Whereas some of the smallest pests may not be excluded by 0.6 mm screening, virtually all other pests are larger (see pest group-specific text below) and are expected to be excluded.

Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). The United States import restrictions barring soil carried with propagative horticultural plants effectively prevent the introduction of many mollusks (Robinson, 1999). Screens and doors exclude the entry of flying or crawling pests that cannot fit through screens (Bessin, 2001; Roosjen *et al*., 1999; Metcalf and Metcalf, 1993). The greenhouse enclosure provides a physical barrier to plants' exposure to fungal spores that are rain splashed (such as *Guignardia miribelii, Macrophoma ehretia* and *Meliola buxicola*) or windborne (such as *Guignardia miribelii, Meliola buxicola,* or *Puccinia buxi*) (Agrios, 1997; Pirone, 1978; Barry, 1996). Standard greenhouse sanitation includes removal of plant debris, and cleaning and disinfection of tools and facilities. These essential practices are commonly recommended to prevent fungal infections (Agrios, 1997; Pirone, 1978; Barry, 1996).

(5) Plants must be rooted and grown in an active foliar state for at least four consecutive months before export[1]. The greenhouse must be used solely for exports to the United States.

This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999) including fungal diseases that require time to develop symptoms (Agrios, 1997; Roosjen *et al*., 1999; Van der Plank, 1963).

(6) Plants must be grown from seeds germinated in the greenhouse or descended from a mother plant that was grown for at least nine months in the exporting country. If the mother plant was imported into the exporting country, then it must be grown for at least twelve months prior to establishment of the descendent plants, or treated at the time of importation into the exporting country with a treatment for pests of the plant as prescribed by the plant protection service of the exporting country and then grown for nine months prior to establishment of descendent plants.

This measure prevents disease and pest transmission from mother plants to asexually produced progeny. This requirement specifically addresses the potential risk of exotic pest spread via recently imported mother stock. This measure and (2) above are primarily important in reducing risks of exotic pests transmitted during vegetative propagation, such as fungal pathogens, leafminers, scales, mealybugs and aphids. Because it is intended to prevent transmission of pests not native to the exporting country, this measure was not considered in evaluating those pests identified in the risk assessments for penjing plants in media from China (*i.e.*, pests known to occur in China). Thus, although the mitigation is essential, it will not be discussed further in this risk management document.

[1] This period will be extended to 6 months. Rooting will also be permitted in pots of approved growing media on raised benches outside the greenhouse. See Section C above and items (12) and (13) below.

(7) Plants must be watered only with rainwater that has been boiled or pasteurized, with clean well water, or with potable water.

Well-water is the preferred source for irrigation, since it is generally pathogen-free (Jones and Benson, 2001), while untreated pond or river water may carry disease organisms or pesticides (Rideout *et al*., 1994). Other sources, such as potable municipal water or boiled water are also expected to be pathogen free, although they may be more costly for the grower. Good water quality is important for plant growth (Bodman *et al*., 1996; Jones and Benson, 2001), and the ability of some fungi, nematodes, and soil-borne vectors of viruses to be transported in water is reduced or eliminated by the use of clean water sources (Roosjen *et al*., 1999).

(8) Plants must be rooted and grown in approved growing media on benches supported by legs and raised at least 46cm off the floor.

A height of 46cm is the minimum height needed to prevent spread of plant-parasitic nematodes, particularly, *Meloidogyne incognita*, from plant to plant via irrigation or rain water splash (Ko *et al*., 1997). We assume that the water splash dispersal of other nematodes is similar to that of *M. incognita*, and that this control is effective against their spread as well. Yang and TeBeest, (1992), determined that 90 percent of the stem lesions on rice plants that resulted from rain splashed spores of the fungus *Colletotrichum gloeosporioides* were distributed to a height of 10 to 15cm. Furthermore, bench heights greater than 46 cm make inspections easier to perform (Kessler, 1999; Kahn and Mathur, 1999), and improve regulatory compliance. (Ko *et al*., 1997).

Growing the plants on raised benches is an additional physical barrier to snails that might inhabit the cool damp floor of the greenhouse (Hollingworth and Sewake, 2002).

(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.

These requirements prevent contamination by pests that had been excluded from the growing environment (Roosjen *et al*., 1999).

These requirements reinforce the good sanitation practices outlined in (4) above.

(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases by an APHIS inspector or an inspector of the plant protection service of the country of origin.

Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Whereas the larger organisms, such as Homoptera and Lepidoptera may be seen directly, even very small pests, such as Thysanoptera and fungal pathogens eventually cause visible damage (Agrios, 1997; Roosjen *et al*., 1999; Van der Plank, 1963).

(11) Plants over two years of age must spend at least two years in the greenhouse to mitigate against any infestation with longhorned beetles *Anoplophora* spp.

In China, the Asian longhorned beetle (*Anoplophora glabripennis*) requires one to two years to develop from egg to adult (Li and Wu, 1993; Xiao, 1980). Other *Anoplophora* species have life cycles similar in length (Courneya and Cavey, 2001). The members of this genus are large (56 mm long by 10 mm wide) beetles (Courneya and Cavey, 2001). Females oviposit in branches and trunks greater than 3 cm in diameter (Xiao, 1980). Plants less than two years of age are unlikely to have sufficient girth for oviposition. Requiring plants over two years old to have been grown for the previous two years in the greenhouse provides sufficient time for the emergence and detection of beetles from plants infested prior to entering the greenhouse. Furthermore, the greenhouse structure prevents exposure of uninfested trees to potential ovipositing adults outside.

(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse, they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.

See the discussion of the impact of 46cm bench height in item (8) above. Studies on APHIS-approved growing media found that pathogens are not present (Palm, 1994; Santacroce, 1991) and are discussed in item (1) above. Pots prevent soilborne pests from gaining access to plants, and limits spread in the event a plant is infested or infected. Plants rooted outside the greenhouse (but still only in APHIS approved growing media) will be dipped in pesticides to control the range of pests of concern prior to entering the greenhouse. Hogan *et al*. (1983) reported significant reductions in nematode populations on *Buxus* even when nematicides were applied to field soils. Similarly, Benson and Barker (1979) reported population reductions of 97 to 98 percent after soil applications of nematicides to *Buxus*. The Benson and Barker study examined control of *Meloidogyne* species, an endoparasitic genus living at least partially within the root, while the nematodes reported to attack penjing are ectoparasites whose population would be more exposed to washing and the pesticide dip. Both of the cited studies were made using soil applications as opposed to bare root dips as proposed here. Nematodes presumably would be less likely to escape treatment in a dip as compared to soil applications.

(13) Water source must comply with 319.37-8(e)(v): (see Section B (7) above) whether cuttings are established inside or outside a greenhouse.

Cuttings must be safeguarded against waterborne pests whether rooted inside our outside the greenhouse. See item (7) above.

(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with pesticides to control mites, insects and fungi at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.

Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999). This is particularly effective against the Homoptera and Lepidoptera whose later life stages are larger and more readily detected (Borror *et al*., 1989), as well as the fungal diseases that require time to develop symptoms (Agrios, 1997; Roosjen, *et al*., 1999; Van der Plank, 1963).

Even more cryptic pests such as nematodes (Bell, 2003; Ferris, 2001), aphids (NEGFG, 2003) and scales (CPC, 2003) may be detected. The six month greenhouse requirement is similar to the four month requirement in item (5), but it provides even greater opportunity for pest detection.

The mitigation measures described above include physical and cultural measures designed to establish and maintain a pest-free production environment. Recognizing that no one measure may be 100 percent effective and that there is a need for redundancy of measures, APHIS also requires the use of pesticide controls. In response to comments received on the proposed rule for the importation of penjing plants in growing media (FR 65: 56803-56806, September 20, 2000), APHIS has increased the frequency of mandatory pesticide applications from once every 30 days to a minimum of once every 10 days. Numerous greenhouse pest control recommendations exist (*e.g.*, NEGFG, 2003; Gould *et al.*, 2003). Pest specific controls are discussed below.

Relationship between phytosanitary mitigations and targeted quarantine pests

Table 2 summarizes the pests of concern and their respective hosts as identified in the associated plant pest risk assessment documents (USDA, 2003a; 2003b; 2003c; 2003d; 2003e). Whereas most of the mitigations target several pests, they do not all apply to all pests. Table 3 indicates which specific mitigations target given pests. In this table, the numbers in the second column (Mitigations) refer to the requirements detailed in Section B. (Program Requirements for Plants in Growing Media).

Table 2: Quarantine Pests to be Mitigated from Chinese Penjing Plants

Classification	Pest Species	Host(s)
Insecta		
Coleoptera: Scarabaeidae	*Anomala cupripes* Hope	*Buxus*
Coleoptera: Curculionidae	*Sympiezomias velatus* Chevrolat	*Buxus, Serissa*
Heteroptera: Aphididae	*Neophylaphis burostris* Qiao, Zhang, & Cao	*Podocarpus*
Heteroptera: Aleyrodidae	*Aleurotuberculatus hikosanensis* Takahashi	*Buxus*
Heteroptera: Coccidae	*Ceroplastes japonicus* Green *Ceroplastes pseudoceriferus* Green	*Buxus, Podocarpus* *Buxus, Podocarpus*
Heteroptera: Diaspididae	*Fiorinia proboscidaria* Green *Parlagena buxi* (Takahashi) *Parlatoria ziziphi* (Lucas) *Lepidosaphes piniphila* Borchsenius *Lepidosaphes tubulorum* (Ferris) *Unaspis yanonensis* (Kuwana)	*Podocarpus* *Buxus* *Buxus* *Podocarpus* *Podocarpus* *Buxus*
Heteroptera: Fulgoridae	*Lycorma deticatula* White	*Buxus*
Heteroptera: Margarodidae	*Drosicha corpulenta* (Kuwana) *Icerya seychellarum* (Westwood)	*Podocarpus* *Podocarpus*
Heteroptera: Pseudococcidae	*Rhizoecus hibisci* Kawai & Takagi	*Serissa, Podocarpus, Ehretia, Sageretia*
Heteroptera: Ricaniidae	*Ricania sublimbata* Jacobi	*Buxus*
Lepidoptera: Cossidae	*Zeuzera coffeae* Nietner	*Buxus*
Lepidoptera: Geometridae	*Ascotis selenaria* Denis & Schiffermuller	*Buxus*
Lepidoptera: Limacodidae	*Thosea sinensis* (Walker)	*Buxus*
Lepidoptera: Psychidae	*Clania minuscula* Butler *Cryptothelea variegata* Snellen	*Buxus* *Buxus, Podocarpus*

Classification	Pest Species	Host(s)
Lepidoptera: Zygaenidae	*Pryeria sinica* Moore	*Buxus*
Orthoptera: Tridactylidae	*Tridactylus japonicus* de Hoan	*Buxus*

Thysanoptera: Thripidae	*Thrips palmi* Karny	*Podocarpus, Sageretia, Serissa*
Mollusca		
Gastropoda: Bradybaenidae	*Acusta ravida* Benson	*Buxus, Podocarpus, Ehretia, Sageretia*
Gastropoda: Philomycidae	*Incilaria sp.*	*Serissa, Podocarpus, Ehretia*
Gastropoda: Succineidae	*Succinea horticola* Reinhart	*Buxus, Ehretia, Sageretia*
Gastropoda: Veronicellidae	*Sarasinula plebeia* (Fischer)	*Serissa*
Fungi		
Ascomycetes: Dothideales	*Guignardia miribelii* Van der Aa *Sphaerella podocarpi* Cooke	*Buxus* *Podocarpus*
Ascomycetes: Erysiphales	*Uncinula ehretiae* Keissl	*Ehretia*
Ascomycetes: Meliolales	*Meliola buxicola* Doidge	*Buxus*
Ascomycetes: Pleosporales	*Leptosphaeria* sp.	*Sageretia*
Basidiomycetes: Aphyllophorales	*Phellinus noxius* (Corner)	*Podocarpus*
Basidiomycetes: Uredinales	*Aecidium sageretiae* *Melampsora serissicola* Shang, Li, & Wang *Phakospora ehretiae* Hirats. *Puccinia buxi* DC *Uredo ehretiae* Barclay *Uredo garanbiensis* Hirats & Hash	*Sageretia* *Serissa* *Ehretia* *Buxus* *Ehretia* *Ehretia*
Fungi Imperfecti: Coelomycetes	*Macrophoma ehretiae* Cooke & Mass *Pestalosphaeria jinggangensis* Zhu, Ge, & Xu *Pestalotia diospyri* Sydow *Phomopsis* sp.	*Buxus, Ehretia* *Podocarpus* *Podocarpus* *Serissa*
Fungi Imperfecti: Hyphomycetes	*Pseudocercospora ehretia* Goh & Hsieh *Pseudocercosporella ehretia-thyrsiflora* Sawada ex. G & H	*Ehretia* *Ehretia*
Nematoda		
Tylenchida: Belonolaimidae	*Tylenchorhynchus crassicaudatus* Williams *Tylenchorhynchus leviterminalis* Siddiqi, Mukherjee, & Dasgupta	*Serissa, Podocarpus, Ehretia, Sageretia* *Serissa, Podocarpus, Ehretia, Sageretia*
Dorylaimida: Xiphinemidae	*Xiphinema brasiliense* Lordello	*Serissa, Podocarpus, Ehretia, Sageretia*

Table 3: Summary of Mitigations as they apply to identified quarantine pests

Pest Species	Mitigations
Anomala cupripes Hope	*1, 2, 3, 4, 5, 9, 10,12, 14*
Anoplophora spp. [1]	*2, 3, 4, 5, 10, 11, 14*
Sympiezomias velatus Chevrolat	*1, 2, 3, 4, 5, 9, 10, 12, 14*
Neophylaphis burostris Qiao, Zhang, & Cao	*2, 3, 4, 5,,9, 10, 12, 14*
Aleurotuberculatus hikosanensis Takahashi	*2, 3, 4, 5, 9, 10, 12, 14*
Ceroplastes japonicus Green	*2, 3, 4, 5,9, 10, 12, 14*
Ceroplastes pseudoceriferus Green	*2, 3, 4, 5,9, 10, 12, 14*
Fiorinia proboscidaria Green	*2, 3, 4, 5,9, 10, 12, 14*
Parlagena buxi (Takahashi)	*2, 3, 4, 5,9, 10, 12, 14*

Pest Species	Mitigations
Parlatoria ziziphi (Lucas)	*2, 3, 4, 5,,9, 10, 12, 14*
Lepidosaphes piniphila Borchsenius	*2, 3, 4, 5, 9, 10, 12, 14*
Lepidosaphes tubulorum (Ferris)	*2, 3, 4, 5, 9, 10, 12, 14*
Unaspis yanonensis (Kuwana)	*2, 3, 4, 5, 9, 10, 12, 14*
Lycorma deticatula White	*2, 3, 4, 5, 9, 10, 12, 14*
Drosicha corpulenta (Kuwana)	*2, 3, 4, 5, 9, 10, 12, 14*
Icerya seychellarum (Westwood)	*2, 3, 4, 5, 9, 10, 12, 14*
Rhizoecus hibisci Kawai & Takagi	*1, 2, 3, 4, 5, 7,9, 10, 12, 14*
Ricania sublimbata Jacobi	*2, 3, 4, 5, 9, 10, 12, 14*
Zeuzera coffeae Nietner	*2, 3, 4, 5, 9, 10, 12, 14*
Ascotis selenaria Denis & Schiffermuller	*1, 2, 3, 4, 5, 9, 10, 12, 14*
Thosea sinensis (Walker)	*2, 3, 4, 5, 9, 10, 12, 14*
Clania minuscula Butler	*2, 3, 4, 5, 9, 10, 12, 14*
Cryptothelea variegata Snellen	*2, 3, 4, 5, 9, 10, 12, 14*
Pryeria sinica Moore	*2, 3, 4, 5, 9, 10, 12, 14*
Tridactylus japonicus de Hoan	*1, 2, 3, 4, 5, 9, 10, 12, 14*
Thrips palmi Karny	*1, 2, 3, 4, 5, 9, 10, 12, 14*
Acusta ravida	*1, 2, 3, 4, 5, 7, 8, 6,9, 10, 12, 14*
Incilaria sp.	*1, 2, 3, 4, 5, 7, 8, 6,9, 10, 12, 14*
Succinea horticola Reinhart	*1, 2, 3, 4, 5, 7, 8, 6,9, 10, 12, 14*
Sarasinula plebeia (Fischer)	*1, 2, 3, 4, 5, 7, 8, 6,9, 10, 12, 14*
Aecidium sageretiae	*2, 3, 4, 5, 9, 10, 12, 14*
Guignardia miribelii Van der Aa	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Leptosphaeria sp.	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Sphaerella podocarpi Cooke	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Uncinula ehretiae Keissl	*2, 3, 4, 5 8, 9, 10, 12, 14*
Meliola buxicola Doidge	*1, 2, 3, 4, 5, 9, 10, 12, 14*
Phellinus noxius (Corner)	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Melampsora serissicola Shang, Li, & Wang	*2, 3, 4, 5, 9, 10, 12, 14*
Phakospora ehretiae Hirats.	*2, 3, 4, 5, 9, 10, 12, 14*
Puccinia buxi DC	*2, 3, 4, 5, 9, 10, 12, 14*
Uredo ehretiae Barclay	*2, 3, 4, 5, 9, 10, 12, 14*
Uredo garanbiensis Hirats & Hash	*2, 3, 4, 5, 9, 10, 12, 14*
Macrophoma ehretiae Cooke & Mass	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Pestalosphaeria jinggangensis Zhu, Ge, & Xu	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Pestalotia diospyri Sydow	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Phomopsis sp.	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Pseudocercospora ehretia Goh & Hsieh	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Pseudocercosporella ehretia-thyrsiflora Sawada ex. G & H	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Tylenchorhynchus crassicaudatus Williams	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Tylenchorhynchus leviterminalis Siddiqi, Mukherjee, & Dasgupta	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*
Xiphinema brasiliense Lordello	*1, 2, 3, 4, 5, 7,8,9, 10, 12, 13, 14*

[1] No *Anoplophora* spp. were identified as specific pests of the five plant species analyzed, however, because of the polyphagous nature of these pests and because interceptions have been made on artificially dwarfed plants not

previously identified as hosts for these pests (Courneya and Cavey, 2001), 7 CFR ' 319.37-5 (q) requires that these conditions be met for artificially dwarfed plants two years-old or older.

Soil-borne arthropods
Anomala cupripes
Sympeizomias velatus
Tridactylus japonicus

The scarab beetle (*Anomala cupripes*) feeds on fine plant roots and decaying vegetable matter as larvae, has a one year life cycle, pupates in the ground and are strong fliers as adults (Hogue, 1993). The weevil (*Sympeizomias velatus*) larvae, and pygmy mole crickets (*Tridactylus japonicus*) (Metcalf and Metcalf, 1993) also are soil inhabitants as larvae and develop into mobile adult forms. Adult mole crickets are plump, winged and 1 to 1.25 inches long. They are seldom seen, because they stay underground most of the time. They fly and mate twice a year in the spring and fall. At these times, one can find their exit holes of an inch or more in diameter (Brandenburg, 2003).

Mitigation Measure	Evidence
(1) Plants must be established in approved unused growing media.	Based on the biology of the Scarabaeidae, Curculionidae and Tridactylidae (Borror *et al*., 1989), this requirement initially controls or eliminates soil-inhabiting stages of scarab (*Anomala cupripes*) and weevil (*Sympeizomias velatus)* larvae, and pygmy mole crickets (*Tridactylus japonicus*) (Metcalf and Metcalf, 1993). These Scarabs oviposit and pass through their larval stages in soil (Hogue, 1993; Chu *et al.*, 1982); unused approved media would not likely to be infested with these life stages. The ovipositional preference for this pest (in order of preference) is compost : loam (1:1)>sand>compost>loam>clay (Chu *et al*., 1982); none of these are APHIS approved media.
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). *Anomala cupripes* are relatively large beetles, > 5 mm wide, (Chu *et al.,* 1982) and should be relatively easy to detect during inspections. Likewise, adult weevils (*Sympiezomias velatus*) are large and highly visible (Borror *et al*., 1989). Access ensures compliance with APHIS requirements and serves

Mitigation Measure	Evidence
	as a deterrent by providing a mechanism for removal from the program if pests are found (Kahn and Mathur, 1999).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	*Anomala cupripes* are relatively large beetles, > 5 mm wide, (Chu *et al.,* 1982) and would be excluded by the required screening. Likewise, adult weevils (*Sympiezomias velatus*) and mole crickets are large (*Tridactylus japonicus*) and would also be excluded (Borror *et al*., 1989) as are the adult crickets (25-30 mm in length) (Brandenburg, 2003). Entryways equipped with automatically closing doors exclude flying adults of these pests (Jones and Benson, 2001). Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963).
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). This is particularly effective against the pests whose later life stages are larger and more readily detected (Borror *et al*., 1989). The six month period will also allow for readily detected plant damage (*e.g.*, exit holes of an inch or more) to develop (Brandenburg, 2003).
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	These requirements ensure that soil-borne pests, such as *Anomala cupripes* (Coleoptera: Scarabaeidae), *Sympeizomias velatus* (Coleoptera: Curculionidae) and *Tridactylus japonicus* (Orthoptera: Tridactylidae) cannot easily access plants prior to shipping [see (1) above]. These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). This is particularly effective against these pests whose later life stages are larger and more readily detected (Borror *et al*., 1989). Regular inspections are recognized as an important part of a balanced pest

Mitigation Measure	Evidence
	management program (Roosjen *et al.*, 1999).
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	Requiring the use of APHIS approved media helps ensure that soil-borne pests, such as *Anomala cupripes* (Coleoptera: Scarabaeidae), *Sympeizomias velatus* (Coleoptera: Curculionidae) and *Tridactylus japonicus* (Orthoptera: Tridactylidae) cannot easily access plants (see (1) above). Washing roots prior to entering the greenhouse further reduces the chance of infestation by soil-borne stages. Chemical controls are available for all three of these pests or their close relatives (Chu *et al.*, 1982; Brandenburg, 2003; Gould *et al.*, 2003).
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse, plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999). This is particularly effective against these pests whose later life stages are larger and more readily detected (Borror *et al*., 1989). Regular inspections are recognized as an important part of a balanced pest management program (Roosjen et al., 1999). Chemical controls are available for all three of these pests or their close relatives (Chu *et al.*, 1982; Brandenburg, 2003; Gould *et al.*, 2003).

Medium to Large Foliage Feeding Arthropods
Ascotis selenaria
Thosea sinensis
Clania minuscule
Cryptothelea variegata
Pryeria sinica

The Giant Looper, *Ascotis selenaria*, is known as a serious pest of various crops including tea, citrus, avocado, teak, coffee and peanuts (Izhar and Wysoki, 1995). The female adult lives for only 5 to 6 days during which it lays up to 3000 eggs. Larvae hatch during spring and summer and reach a maximum size of 6 cm before pupating in the soil (Izhar and Wysoki, 1995). Larvae of *Ascotis selenaria*, when disturbed, stand nearly erect on the posterior prolegs, remain motionless and resemble small twigs (Borror *et al.*, 1989). *Thosea* spp. are moderately sized moths (ca. 30 – 40 mm) (HKLS, 2003). The slug caterpillar (*Thosea sinensis*) and the tea bagworm (*Clania minuscule*) are common pests of tea in Asia (CPC, 2002). Like *Clania minuscule*, *Cryptothelea variegata* is a bagworm. Larvae of *C. variegata* measure about 10 mm. The adult is a medium-sized wasp- mimic, with a forewing length of 10-13 mm in the male and 12-14 mm in the female. The mature larva is 15-22 mm in length (Brown, 2003).

Mitigation Measure	Evidence
(1) Plants must be established in approved unused growing media**.**	Larvae of *Ascotis selenaria* hatch during spring and summer and reach a maximum size of 6 cm before pupating in the soil (Izhar and Wysoki, 1995). This requirement initially controls or eliminates soil-inhabiting stage of this pest.
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). The relatively large size of all these pests (Izhar and Wysoki, 1995; Borror *et al.*, 1989; HKLS, 2003; Brown, 2003) and the production of silken "bags" by *Clania* and *Cryptothelea* species (USDA, 1985) and the defoliation caused by feeding of *Pryeria sinica* (Bean, 2003) would allow detection of these pests at least during some stages of their development.
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	These are all relatively large pests (Izhar and Wysoki, 1995; Borror *et al.*, 1989; HKLS, 2003; Brown, 2003) that would be excluded by the required screening. Entryways equipped with automatically closing doors exclude flying adults of these pests (Jones and Benson, 2001). Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963).
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). This is particularly effective against those pests whose

Mitigation Measure	Evidence
for exports grown in compliance with 7 CFR § 319.37-8.	later life stages are larger and more readily detected (Borror *et al*., 1989). The relatively large size of all these pests (Izhar and Wysoki, 1995; Borror *et al.*, 1989; HKLS, 2003; Brown, 2003), the production of "bags" by *Clania* and *Cryptothelea* species (USDA, 1985) and the defoliation caused by feeding of *Pryeria sinica* (Bean, 2003) would allow these pests to be detected at least during some stages of their development.
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	These requirements ensure that the soil-borne pest *Ascotis selenaria* cannot easily access plants (see (1) above). Packing and storing in pest–free areas helps prevent reinfestation by all of these pests. These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). This is particularly effective against these pests whose later life stages are larger and more readily detected (Borror *et al*., 1989). The relatively large size of all these pests (Izhar and Wysoki, 1995; Borror *et al.*, 1989; HKLS, 2003; Brown, 2003), the production of "bags" by *Clania* and *Cryptothelea* species (USDA, 1985) and the defoliation caused by feeding of *Pryeria sinica* (Bean, 2003) would allow detection of these pests at least during some stages of their development.
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	Requiring the use of APHIS approved media helps ensure that the soil-borne stage of *Ascotis selenaria* cannot easily access plants (see (1) above). Washing roots prior to entering the greenhouse further reduces the chance of infestation by soil-borne stages. Chemical controls are available for these pests or their close relatives (Izhar and Wysoki, 1995; INCHEM, 1984).
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). This is particularly effective against those pests whose

Mitigation Measure	Evidence
pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	later life stages are larger and more readily detected (Borror *et al*., 1989). The relatively large size of all these pests (Izhar and Wysoki, 1995; Borror *et al*., 1989; HKLS, 2003; Brown, 2003, production of "bags" by *Clania* and *Cryptothelea* species (USDA, 1985) and the defoliation caused by feeding of *Pryeria sinica* (Bean, 2003) all would allow detection of these pests at least during some stages of their development. Chemical controls are available for these pests or their close relatives (Izhar and Wysoki, 1995; INCHEM, 1984).

Aphids, Whiteflies, Leafhoppers and Planthoppers
Neophylaphis burostris
Aleurotuberculatus hikosanensis
Lycorma deticatula
Ricania sublimbata

About 30 species of aphids, including *Neophylaphis burostris,* can be found in greenhouses, depending on the crop and geographic location (Blackman and Eastop 1984; Miller and Stoetzel 1997). Usually, aphids are small (less than 1/8 inch [3 mm] long), soft-bodied insects with long legs, long antennae and a pair of tube-like structures called cornicles projecting from the posterior end (NEGFG, 2003). Aphids are sucking insects that remove plant sap and cause distorted growth. Aphids void waste as a sugar-rich liquid called honeydew that attracts ants and promotes growth of black-colored fungi called sooty mold. In addition, some aphids also transmit viral plant diseases (NEGFG, 2003). Many aphid species reproduce sexually only under specific environmental conditions, often those associated with the onset of winter. During spring and summer, reproduction is asexual, with unmated adult female aphids giving birth directly to live young, all of which are female. This process, coupled with the high fecundity of many aphids (some species giving birth to as many as 60 to 100 young [nymphs] over a period of 20 to 30 days) and the quick maturation of aphids (as little as 7 to 10 days between generations) allows populations of aphids to increase quickly NEGFG, 2003).

Aleurotuberculatus hikosanensis is a member of the group of insects known as whiteflies. Most whiteflies feed on woody plants and are not found in greenhouses (NEGFG, 2003). Adults and nymphs of both species are generally found on the underside of the foliage of preferred host plants. Nymphs feed on plant sap and secrete large quantities of honeydew, which promotes the development of sooty mold. Severe infestations may defoliate plants (NEGFG, 2003). Whitefly adults are winged, white to yellow in color, and approximately 2 mm long (NEGFG, 2003). Females may live up to six weeks and produce 30 to 200 eggs but length of the life cycle of each species varies with temperature. Eggs are usually found on the new growth, while older stages are found on the lower leaves (NEGFG, 2003).

Tropical Fulgorids, like *Lycorma deticatula* which is a member of the Fulgoridae, account for some of the largest planthoppers. The species in the United States seldom reach a size greater than 10-12 mm, but some tropical species reach a length of 50 mm or more (Borror *et al.*, 1989). The planthoppers feed on plant juices and, like the aphids and whiteflies, produce honeydew. Very few planthoppers cause economic damage to cultivated plants (Borror *et al.*, 1989). *Ricania sublimbata* is a member of the Ricaniidae. Members of the Ricaniidae family are medium to large planthoppers ranging in size from 7 to 17 mm depending on the species. Many species are brown and white and are sometimes mistaken for tiny moths because of the dark colored patterns on their wings. Ricaniidae have large triangular shaped wings which they hold in a tent-like fashion above the body when at rest (CSIRO, 2003). Some species of Ricaniidae are known to damage crops and ornamental plants such as the passionvine hopper, which is a pest of passionvines, pumpkins, citrus, jasmine, wisteria and various ferns. Both the adults and nymphs suck the sap from host plants which causes wilting and stunted growth. These insects also produce honeydew in great quantities which often leads to sooty mold (CSIRO, 2003).

Mitigation Measure	**Evidence**
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Whitefly infestations develop either because immature stages of whiteflies are brought in on cuttings or plants purchased from outside sources, or because year round populations are conserved in parts of a grower's operation, such as the retail sales area or on plants that are held permanently as stock plants (NEGFG, 2003). Use of clean mother stock therefore reduces the likelihood of whitefly introduction. Checking of new cuttings or plants on arrival helps in managing infestations by identifying incipient infestations (NEGFG, 2003). Similarly, careful inspection of all new plants before placing them in the growing areas prevents the introduction of new hopper or aphid species into the greenhouse (NEGFG, 2003).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). Sanitation is an important part of aphid control (NEGFG, 2003).

Mitigation Measure	Evidence
measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	Although research cited in Table 1 indicates that the 0.6 mm mesh screening will not completely exclude whiteflies and aphids, the research (Bethke *et al.*, 1994) indicated significant reductions in insects passing through similarly sized screens. The hoppers are significantly larger (see discussion above) and would likely be excluded by the screen.
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Nymphs feed on plant sap and secrete large quantities of honeydew, which promotes the development of sooty mold (NEGFG, 2003). Sooty mold is an easily detected nonspecific indicator for the presence of whiteflies, hoppers or aphids. Whiteflies may be monitored within crops by checking the undersides of one or two leaves on 10-20 plants throughout the greenhouse weekly to detect nymphs, pupae, or adults (NEGFG, 2003). Aphids can be detected early by checking several plants on each bench throughout the greenhouse on a weekly basis. Using yellow sticky cards can help detect entrance of winged aphids into the greenhouse in spring or early summer (NEGFG, 2003).
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	Packing and storing in pest–free areas helps prevent reinfestation by these pests. Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). Sanitation is an important part of aphid control (NEGFG, 2003). These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen, *et al*., 1999). Sooty mold is an easily detected nonspecific indicator for the presence of whiteflies, hoppers and aphids. Whiteflies may be monitored within crops by checking the undersides of one or two leaves on 10-20 plants throughout the greenhouse weekly to detect nymphs, pupae, or adults (NEGFG, 2003). Aphids can be detected early by checking several plants on each bench

Mitigation Measure	Evidence
	throughout the greenhouse on a weekly basis. Using yellow sticky cards can help detect entrance of winged aphids into the greenhouse in spring or early summer (NEGFG, 2003).
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	Chemical controls are available for these pests or their close relatives (Gould *et al*., 2003; NEGFG, 2003; PIC, 2001).
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al*., 1999). Sooty mold is an easily detected nonspecific indicator for the presence of whiteflies, hoppers and aphids. Whiteflies may be monitored within crops by checking the undersides of one or two leaves on 10 to 20 plants throughout the greenhouse weekly to detect nymphs, pupae, or adults (NEGFG, 2003). Aphids can be detected early by checking several plants on each bench throughout the greenhouse on a weekly basis. Using yellow sticky cards can help detect entrance of winged aphids into the greenhouse in spring or early summer (NEGFG, 2003). Chemical controls are available for these pests or their close relatives (Gould, *et al*., 2003; NEGFG, 2003; PIC, 2001). Young aphids of some species may reside between scales of leaf buds or in flowers. This reduces their contact with nonsystemic pesticides and repeated applications may be needed for control. Coverage of plant parts with wettable or soluble powder formulations may be improved by the use of surfactants. In some cases, insecticidal soaps and highly refined horticultural oils can provide effective aphid control (NEGFG, 2003). For chemical control of whiteflies, there are three options: foliar wet sprays directed against nymphs, smoke fumigation directed

Mitigation Measure	Evidence
	against adults, or soil-applied systemics used against nymphs. Eggs and pupae are usually not killed by chemical applications, regardless of manner of application. Fumigation may provide better control than contact foliar sprays especially for plant species or crop densities in which good coverage is hard to achieve.Several repetitions will be needed over a 2-3 week period to kill adults that emerge from nymphs and pupae (NEGFG, 2003).

Scales and Mealybugs
Ceroplastes japonicus
Ceroplastes pseudoceriferus
Fiorinia proboscidaria
Parlagena buxi
Parlatoria ziziphi
Rhizoecus hibisci
Lepidosaphes piniphila
Lepidosaphes tubulorum
Unaspis yanonensis
Drosicha corpulenta
Icerya seychellarum
Rhizoecus hibisci

Ceroplastes japonicus and *Ceroplastes pseudoceriferus* are members of a group of pests known as wax scales. Adult females are parthenogenic and each female produces 1000 or more eggs, which hatch after 2 or 3 weeks. The females have three nymphal stages. Only the first instars are capable of locomotion because they seek out a suitable feeding site. Other stages are sessile (CPC, 2003). Wax scales damage plants not only because of the presence of large numbers of conspicuous waxy scales, but also because of the sooty mold which grows on the copious quantities of honeydew excreted by the insects. Sooty mold blocks light and air from the leaves and impairs photosynthesis (CPC, 2003). Heavy infestations may cause chlorotic spotting on the leaves (which may be shed prematurely), dieback of stems and wilting. Mature adult females of *C. ceriferus*, a closely related species, are covered with thick, white, amorphous wax and are hemispherical, and up to 12 mm in length and 10 mm in width (CPC, 2003).

Parlatoria ziziphi, black parlatoria scale, is often intercepted on imported citrus produce (PIN 309, 2003) and is also an armored scale. Its life history is similar to the scales above except that reproduction is sexual rather than parthenogenic (CPC, 2003). Infestations of *P. ziziphi* occur on the shoots, foliage and fruit. The depletion of plant sap leads to reduced host vigor and the foliage and fruit may be discolored with yellow streaking and spotting. Heavy infestations may result in premature shedding of the leaves and fruit. In heavy infestations, the subrectangular black scale covers on leaves and shoots are clearly visible (CPC, 2003). The scale cover of the adult female is 0.6 to 0.75 mm long and 1.25 to 1.4 mm wide while the scale of the pre-adult male is white, 0.8 mm long, flat (CPC, 2003). *Lepidosaphes* and *Fiorinia* species are also armored scales with life histories similar to *Parlatoria* (CPC, 2003). The arrowhead scale, *Unaspis yanonensis*, is an armored scale pest of citrus (CPC, 2003; PNKTO #45, 1984). Attacked plants show inhibited growth, yellow blotches and necrosis of leaves, leaf drop, shortened or dead branches and small deformed fruits. Large masses of male white scales may be seen on twigs with darker curved female scales. In cases of severe attacks, tree mortality has been observed (CPC, 2003). Adult female scale covers are oyster-shell shaped, 2.5 to 3.6 mm, blackish-brown with a paler margin. Immature male scale covers are elongate, 1.3 to 1.6 mm, felted white, with two or three longitudinal ridges (PNKTO #45, 1984).

Both *P. ziziphi* and *U. yanonensis* primarily attack citrus and are unlikely to be found on the penjing plant species analyzed, although a report exists (PNKTO #44; PNKTO #45; China, 1994, 1995).

Icerya seychellarum and *Drosicha corpulenta* belong to the family Margarodidae, the giant Coccids. *I. seychellarum* lives on a wide variety of hosts, especially woody plants (CPC, 2003). Giant Coccids have three immature stages. Development from egg to adult usually takes about 3 months. As with all scale insects, the females are wingless and look similar to the immature stages. Males are rare and are not required for reproduction (CPC, 2003). The majority of crawlers eventually settle on the undersides of the leaves and on the young twigs and begins to secrete their distinctive yellow wax body covering. The females remain on the leaves and twigs throughout their lives, eventually producing ovisacs. Unlike some of the related species of *Icerya, I. seychellarum* does not congregate in masses, but is rather generally distributed over the tree (CPC, 2003*)*. This pest is found along major veins on the lower surfaces of the leaves of host plants, and can be recognized by its large size (up to 10 mm long) with granular white or pale-yellow wax and copious quantities of associated honeydew (CPC, 2003).

Drosicha and *Icerya* species are coccids, some of which are important pests of tropical fruit crops (Tandon, 1997). Foliage-feeding coccids (mealybugs and scales) are often introduced to the greenhouse on infested plants (NEGFG, 2003). Nymphs and adult females cause malformation and discoloration of plant structures by injecting toxic saliva into plant tissue and by removing sap with piercing-sucking mouth parts. Coccids excrete honeydew, supporting the growth of sooty mold. Sooty mold will interfere with photosynthesis and make plants unattractive (NEGFG, 2003).

Rhizoecus hibisci, Rhizoecus root mealybug, is widely distributed in east and southeast Asia, and has also been found in Puerto Rico, Florida and Hawaii (Hara and Niino-Duponte, 1999; ScaleNet, 2003). Damage by the root mealybug is nonspecific in that the most common symptoms are slow plant growth, lack of vigor and subsequent death. Root mealybug is not evident unless the root ball is examined by removing the plant's pot. White, waxy substance and adult females will be noticeable especially between the pot and root ball (Hara and Niino-Duponte, 1999). The adult female lives from 27 to 57 days and can give birth to 17 to 83 young in one, two or three litters. White, cottony-like masses containing egg-laying females and/or eggs are normally visible on the outside of the root mass when an infested plant is lifted from its container (Hara and Niino-Duponte, 1999). The adult female root mealybug is bluish-gray, elongate-oval, up to 2.35 mm in length (Hara and Niino-Duponte, 1999).

Mitigation Measure	Evidence
(1) Plants must be established in approved unused growing media**.**	*Rhizoecus hibisci* root mealybugs feed on the roots (Hara and Niino-Duponte, 1999), particularly the new feeder roots in the upper layer of the soil. Use of pest–free unused approved media effectively controls or eliminates the soil-inhabiting stage of this pest.
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Foliage-feeding mealybugs are often introduced to the greenhouse on infested plants. Early detection and isolation of infested plants is important in mealybug and scale control. (NEGFG, 2003).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). Root mealybugs may be spread by water moving through drainage openings of pots or benches, or by movement of infested soil or plant debris, or by the use of non-sterile equipment. The mealybugs may also migrate to adjacent uninfested areas by crawling or following roots growing through drainage openings of pots. Sanitation is important in preventing introduction and spread (NEGFG, 2003; Hara and Niino-Duponte, 1999).
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR §	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Soft scales and mealybugs (other than root feeding mealybugs)

Mitigation Measure	Evidence
319.37-8.	feed on plant sap and secrete large quantities of honeydew, which promotes the development of sooty mold (NEGFG, 2003). Sooty mold is an easily detected indicator for the presence of whiteflies, hoppers and aphids. Infestations of the armored scales can produce visible symptoms such as chlorosis, streaking, leaf drop, *etc.* (CPC, 2003; PNKTO#44, 1984; PNKTO#45, 1984).
(7) Plants must be watered only with rainwater that has been boiled or pasteurized, with clean well water, or with potable water.	Root mealybugs may be spread by water (NEGFG, 2003); use of clean water may help reduce the likelihood of their introduction and spread.
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	Packing and storing in pest–free areas helps prevent reinfestation by these pests. Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al*., 1999). Sooty mold is an easily detected nonspecific indicator for the presence of above–ground mealybugs and soft scales (CPC, 2003). Infestations of the armored scales can produce visible symptoms such as chlorosis, streaking, leaf drop, *etc.* (CPC, 2003; PNKTO#44, 1984; PNKTO#45, 1984).
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and	Chemical controls are available for these pests or their close relatives (Gould *et al*., 2003; NEGFG, 2003). Application of quinalphos and phoxim or methamidophos resulted in 95% control of C*eroplastes ceriferus* on tea in China (Lai, 1993). Carbofuran was found to be the most effective granular systemic insecticide for control of *C. ceriferus* on camellia in the USA (Nash, 1973). In China, *Parlatoria ziziphi* was effectively controlled with omethoate, chlorpyrifos, methidathion, quinalphos, lambda-cyhalothrin, fenvalerate or cypermethrin (Huang *et al*., 1988).

Mitigation Measure	Evidence
nematodes.	Dekle (1976) advised the use of oil sprays, sprays containing malathion with oil, and sprays of dimethoate or parathion for control of *P. ziziphi* in Florida. Dispersal of scales from plant to plant occurs through the activity of crawlers at points where adjacent plants touch. Thus, spread of infected material can be reduced by pruning and allowing adequate spacing between plants throughout cultivation. Chemical control, where necessary, is usually achieved by spraying with mineral oils at critical points during the season. Mixtures of mineral oils and insecticide (*e.g.* organophosphates) may be used in control (CPC, 2003). Chemical control of root mealybugs by dipping or drenching with liquid insecticides is more effective than granular insecticides. Dursban TNP (4EC) applied twice at 2 week interval as a drench or dip controls the coffee root mealybug (*Geococcus coffeae*). In the dip method, the entire potted plant container is submerged in a diluted Dursban solution (1 pt per 100 gallons) submerging the roots for about 30 seconds. In the drench method, after pre-moistening with irrigation or rainfall, the diluted Dursban solution is poured into each potted plant container to saturate the soil at a rate of 10 to 12 fl. oz. per gallon of container size (Hara and Niino-Duponte, 1999). Raised benches or plastic film prevent root mealybug infestation from the soil beneath (Hara and Niino-Duponte, 1999).
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al*., 1999). Sooty mold is an easily detected indicator for the presence of mealybugs and soft scales (CPC, 2003). Infestations of the armored scales can produce visible symptoms such as chlorosis, streaking, leaf drop, *etc.* (CPC, 2003; PNKTO#44, 1984; PNKTO#45, 1984). Chemical controls are available for these pests or their close relatives (Gould *et al*., 2003; NEGFG, 2003). See comments for preceding measure.

Wood-boring Insects
Zeuzera coffeae

Adult coffee leopard moths (*Zeuzera coffeae*) live for up to 18 days. In that time, females may lay between 190 and 1134 eggs (CPC, 2003). The larvae tunnel within twigs and branches of the host plant, causing the leaves to wither and possibly the branches to die. Seedlings can be killed when the main stem is attacked. Larvae overwinter then pupate in the stems when fully grown. The larval stage lasts for 73-205 days. After emergence the pupal skin protrudes from the exit hole (CPC, 2003). *Zeuzera coffeae* has one to two generations per year (CPC, 2003).

Because of internal boring, branches and twigs wilt quickly and then become brittle and easily break off; there are holes visible from which the frass is exuded (CPC, 2003). The larva, when fully grown, is about 50 mm long and orange-red in color. The adult moth is variable in size, with a wingspan from 30 to 50 mm (CPC, 2003).

The removal and burning of dead and dying branches and seedlings will help to reduce pest numbers (CPC, 2003). Chemical control by injection into the wormholes was shown to be effective by Feng *et al*. (2000). Abraham and Skaria (1995) found that swabbing the main stem as a prophylactic measure was effective.

Mitigation Measure	Evidence
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written agreement … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Checking of new cuttings or plants on arrival helps in managing infestations by identifying incipient infestations (NEGFG, 2003). Because of internal boring, branches and twigs wilt quickly and then become brittle and easily break off; there are holes visible from which the frass is exuded (CPC, 2003). After emergence the pupal skin protrudes from the exit hole (CPC, 2003). These visible signs and symptoms aid in detection of *Z. coffeae*.
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). The removal and burning of dead and dying branches and seedlings will help to reduce pest numbers (CPC, 2003).

Mitigation Measure	Evidence
measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	These are relatively large insects. The fully grown larva is about 50 mm long and the adult moth is variable in size, with a wingspan from 30 to 50 mm (CPC, 2003). They would be excluded by the required screening.
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Because of internal boring, branches and twigs wilt quickly and then become brittle and easily break off; there are holes visible from which the frass is exuded (CPC, 2003). After emergence the pupal skin protrudes from the exit hole (CPC, 2003). These visible signs and symptoms aid in detection of *Z. coffeae*.
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	Packing and storing in pest–free areas helps prevent reinfestation by these pests. Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al.*, 1999; Van der Plank, 1963). These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al*., 1999). Because of internal boring, branches and twigs wilt quickly and then become brittle and easily break off; there are holes visible from which the frass is exuded (CPC,2003). After emergence the pupal skin protrudes from the exit hole (CPC, 2003). These visible signs and symptoms aid in detection of *Z. coffeae*.
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse	Abraham and Skaria (1995) found that swabbing the main stem as a prophylactic measure was effective indicating effective pesticides are available.

Mitigation Measure	Evidence
they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al*., 1999). Because of internal boring, branches and twigs wilt quickly and then become brittle and easily break off; there are holes visible from which the frass is exuded (CPC, 2003). After emergence, the pupal skin protrudes from the exit hole (CPC, 2003). These visible signs and symptoms aid in detection of *Z. coffeae*. The removal and burning of dead and dying branches and seedlings will help to reduce pest numbers (CPC, 2003). Chemical control by injection into the wormholes was shown to be effective by Feng *et al*., (2000). Abraham and Skaria (1995) found that swabbing the main stem as a prophylactic measure was effective indicating effective pesticides are available.

Thrips
Thrips palmi Karny

Thrips palmi Karny (Thysanoptera: Thripidae) is a polyphagous pest, especially of Cucurbitaceae and Solanaceae (CAB, 2002). The life cycle differs slightly from most phytophagous Thripidae because the adults emerge from pupa in the soil and move to the leaves or flowers of the plant, where they lay their eggs (CAB, 2002). *T. palmi* multiply during any season that crops are cultivated, but are favored by warm weather (Capinera, 2000). At 25° C, *T. palmi's* life cycle from egg to egg lasts 17.5 days. Females reproduce with or without copulation (CAB, 2002). Unmated females produce progeny by parthenogenesis (CAB, 2002). Only males are produced by unmated females. Mated females produce predominately females.

The type of plant injury caused by *T. palmi's* feeding is always sucking damage. *T. palmi* prefers to infest leaves. More than 99 percent of the total population infested leaves, while less than 1 percent infested flowers and fruits, regardless of the population density (CAB, 2002). Heavily infested plants are characterized by a silvered or bronzed appearance of the leaves, stunted leaves, and terminal shoots (CAB, 2002).

Mitigation Measure	Evidence
(1) Plants must be established	Based on the biology of *Thrips palmi* (CAB, 2002), this

in approved unused growing media**.**	requirement initially controls or eliminates soil-inhabiting stages this pest. The adults emerge from pupa in the soil and move to the leaves or flowers of the plant, where they lay their eggs (CAB, 2002); therefore, requiring the use of unused approved growing media eliminates soil-inhabiting stages this pest.
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Checking of new cuttings or plants on arrival helps in managing infestations by identifying incipient infestations (NEGFG, 2003). The damage caused by *T. palmi* is easy to identify because it is not unlike that caused by many other species of thrips. When populations are high, their feeding causes a silvery or bronzed appearance on the surface of the plant, especially on the midrib and veins of leaves and on the surface of fruit. Leaves and terminal shoots become stunted and fruit is scarred and deformed (CAB, 2002).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). The risks from soil-borne prepupae, as well as subsequent pupae, are reduced when new media is added to pots, and excess soil and sand is removed from the greenhouse. Although research cited in Table 1 indicates that the 0.6 mm mesh screening will not completely exclude thrips, the research (Ghidiu and Roberts, 2003; Ferguson and Murphy, 2000) indicated significant reductions in insects passing through similarly sized screens. *T. palmi* are good fliers but their small size makes their dispersal susceptible to wind and weather (Martin and Mau, 1992). Their activity peaks during hot weather when updrafts may carry them great distances (Martin and Mau, 1992). In addition, the adults emerge from pupa in the soil and move to the leaves or flowers of the plant,

	where they lay their eggs (CAB, 2002); the risks from soil-borne prepupae, as well as subsequent pupae, are reduced when new media is added to pots, and excess soil and sand is removed from the greenhouse..
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). *T. palmi* are capable of building up to very high numbers quickly under favorable conditions (Glades Crop Care, 2003). When populations are high, their feeding causes a silvery or bronzed appearance on the surface of the plant, especially on the midrib and veins of leaves. Leaves and terminal shoots become stunted (CAB, 2002). The six month time period before export should allow enough time for the pest to be detected.
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	Packing and storing in pest–free areas helps prevent reinfestation by these pests. Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Lewis, 1997; Roosjen *et al*., 1999; Van der Plank, 1963). The adults emerge from pupa in the soil and move to the leaves or flowers of the plant, where they lay their eggs (CAB, 2002); therefore, maintaining an area that is free of soil and sand will help eliminate this risk.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al.*, 1999). Sakimura *et al.*, (1986) observed that both adults and larvae of *T. palmi* feed gregariously on leaves, firstly along the midribs and veins. Stems are attacked, particularly at or near the growing tip, and they are found among the petals and developing ovaries in flowers. They leave numerous scars and deformities, and finally kill the entire plant. Thrips may be monitored within crops by checking the undersides of one or two leaves on 10 to 20 plants throughout the greenhouse weekly. Thrips can be detected early by checking several plants on each bench throughout the greenhouse on a weekly

	basis. Using yellow or blue sticky cards can help detect entrance of winged thrips into the greenhouse (Chen, 2000).
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse in pots containing APHIS approved growing media. When plants are moved to the greenhouse, they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Checking of new cuttings or plants upon moving them into the greenhouse helps in managing infestations by identifying incipient infestations (NEGFG, 2003). The damage caused by *T. palmi* is easy to identify because, when populations are high, their feeding causes a silvery or bronzed appearance on the surface of the plant, especially on the midrib and veins of leaves and on the surface of fruit. Leaves and terminal shoots become stunted (CAB, 2002). In addition, the adults emerge from pupa in the soil and move to the leaves or flowers of the plant, where they lay their eggs (CAB, 2002); so maintaining a greenhouse free of soil and sand will help eliminate this risk.
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests, especially pests exotic to the exporting country and the United States (Roosjen *et al*., 1999). Chemical controls are available for thrips (Williamson, 2001) and there is widespread resistance to numerous chemical control products (Lewis, 1997). Thrips may hide in leaves or in flowers. They also have a rapid life cycle with a high reproduction rate, a wide host range. When using insecticides to control thrips, select a very small droplet size of less than 100 microns to attain more effective contact (Williamson, 2001). Apply insecticides before peak thrips activity (every 2 to 3 weeks) to ensure control of adults before they start to lay eggs (Williamson, 2001). The interval between applications may vary between 3 to 7 days depending on temperature, relative numbers, and stage of the crop (Williamson, 2001). The Penjing Plants in Growing Media requires pesticide applications at least once every ten days, or more frequently if

	required to maintain a pest free condition. When selecting control materials, rotation between classes of insecticides may help to delay the development of resistance (Williamson, 2001). Research suggests that when using a material or combination of materials for one generation (2 to 3 weeks) before switching to an insecticide in another class (Williamson, 2001).

Mollusks
Acusta ravida (syn. *Bradybaena ravida*)
Incilaria sp.
Succinea horticola
Sarasinula plebeia

The terrestrial gastropod *Acusta ravida* (syn. *Bradybaena ravida*) is widely distributed in China as an indigenous species (De-niu *et al.*, 2002). Outside China, the species is also found in southeastern Russia (De-niu *et al.*, 2002). The natural habitat of *A. ravida* is primarily broad-leaved and mixed conifer forests (Likhaev and Rammel'meier, 1952). *A. ravida* is polyphagous feeding on a wide range of plants including the crop species wheat, cotton, rape, soybean, kidney bean, pepper, corn and cabbage (De-niu *et al.*, 2002). *A. ravida* has one generation per year; adults have a lifespan of 1.5 to 2 years and reach approximately 19 mm in size (De-niu *et al.*, 2002). Adults and juveniles overwinter in soil crevices while eggs are deposited in clutches of 20 to 300 eggs 20 to 40 mm deep in the soil in May (De-niu *et al.*, 2002). While resistant to freezing, *B. ravida* is susceptible to desiccation and the eggs are quickly killed in direct sunlight (De-niu *et al.*, 2002).

Succinea horticola is the most important species of the Succineidae family. It is found mainly in Asia, *i.e*., China, Japan and Okinawa, but is also found in Greece and Italy (AFPMB, 1998). This snail is a very severe pest of greenhouses plants and grasses. It is among the twenty snails most commonly intercepted on retrograde military cargo or household effects and was intercepted approximately 150 times from 1974-1987 (AFPMB, 1998).

The slug *Sarasinula plebeia* is the most important pest on bean crops in many parts of Central America. This pest is a polyphagous herbivore, feeding mainly on leaves, buds and soft stems (Rueda *et al.*, 2002). They are nocturnal, hiding during the day under stones, rotten logs and other plant residues on the ground; *S. plebeia* exhibits peak activity between the hours of 2 and 4 a.m. (Rueda *et al.*, 2002). They are hermaphroditic (Rueda *et al.*, 2002).

Most ornamental woody plants and ornamental grasses are not seriously affected by snails and slugs (Ohlendorf, 1999). Snails and slugs are detectable by slime trails, chewed leaves and excrement (Hollingworth and Sewake, 2002). Standard inspection techniques are highly likely to detect larger mature and juvenile forms of mollusks present on plants (Robinson, 2002). Although small eggs in soil are highly likely to escape detection, plants produced in APHIS-approved growing media under pest-exclusionary conditions are expected to be free of mollusk eggs (Santacroce, 1991). The rule governing importation of plants in approved growing media [7 CFR§319.37-8(e)] reduces the risk of plants being contaminated by this species. Specific requirements (see B General Program Requirements for Plants in Growing Media) that mitigate the risk of the quarantine snails include:

Mitigation Measure	Evidence
(1) Plants must be established in approved unused growing media**.**	Based on the biology of the mollusks, this requirement effectively controls or eliminates soil-inhabiting stages. Growing media of the type approved by APHIS are not good pathways for snail movement (Hollingworth and Sewake, 2002). Although small eggs in soil are highly likely to escape detection, plants produced in APHIS-approved growing media under pest-exclusionary conditions (e.g., sterile growing media) are expected to be free of mollusk eggs.
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Snails are detectable by slime trails, chewed leaves and excrement. Since standard inspection techniques are highly likely to detect larger mature and juvenile forms, this would allow snails to be found either before they move into the greenhouse or during required inspections (Robinson, 2002; Santacroce, 1991; CPC, 2003). Access ensures compliance with APHIS requirements and serves as a deterrent by providing a mechanism for removal from the program if pests are found (Kahn and Mathur, 1999).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). The first step in a good snail and slug management program is to eliminate, to the extent possible, all places where snails or slugs can hide during the day. Boards, stones, debris, weedy areas around tree trunks, leafy branches growing close to the ground,

Mitigation Measure	Evidence
soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	and dense ground covers such as ivy are ideal sheltering spots (Ohlendorf, 1999). Plants will be grown solely in greenhouses with sanitary procedures adequate to exclude mollusks and other plant pests, *e.g*., there are no irrigation ditches or other openings in which the snails could gain access. The greenhouse must be free of soil and sand to prevent another potential pathway for entry of snails. In addition plants must be stored and packaged in areas free of soil, sand, earth and plant pests, which would further aid in eliminating snails from the pathway. The requirement for a water source from clean well water, boiled rain water or drinking quality water will further reduce the likelihood of introducing mollusks. Growing the plants on raised benches is an additional physical barrier to snails that might inhabit the cool damp floor of the greenhouse (Bessin *et al*., 1997; Hollingworth and Sewake, 2002; van Rooyen, 2003).
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Snails and slugs are detectable by slime trails, chewed leaves and excrement (Hollingworth and Sewake, 2002). Standard inspection techniques are highly likely to detect larger mature and juvenile forms of mollusks present on plants (Robinson, 2002).
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	These requirements ensure that soil-borne pests, such as mollusks cannot easily access plants (see (1) above). These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Regular inspections are recognized as an important part of a balanced pest management program (Roosjen *et al*., 1999). Snails and slugs are detectable by slime trails, chewed leaves and excrement (Hollingworth and Sewake, 2002). Standard inspection techniques are highly likely to detect larger mature and juvenile forms of mollusks present on plants (Robinson, 2002).
(12) Cuttings may be	Requiring the use of APHIS approved media helps ensure that

Mitigation Measure	Evidence
established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	soil-borne pests, such mollusks cannot easily access plants (see (1) above). Washing roots prior to entering the greenhouse further reduces the chance of infestation by soil-borne stages.
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Regular inspections are recognized as an important part of a balanced pest management program (Roosjen *et al*., 1999). Snails are detectable by slime trails, chewed leaves and excrement. Since standard inspection techniques are highly likely to detect larger mature and juvenile forms, this interval allows snails to be found during required inspections (Robinson, 2002; Santacroce, 1991; CPC, 2003). Chemical controls (primarily baits), cultural controls (barriers) and the physical removal of snails and slugs by handpicking are all effective controls for reducing pest populations when used alone or in combinations (Ohlendorf, 1999; Rueda, 2002).

Fungi: Cankers, Rots and Leafspots
Guignardia miribelii
Leptoshaeria sp.
Macrophoma ehretiae
Pestalosphaeria jinggangensis
Pestalotia diospyri
Phellinus noxius
Phomopsis sp.
Pseudocercospora ehretia
Pseudocercosporella ehretia-thyrsiflora
Sphaerella podocarpi

Guignardia species overwinter in tissues on the plant and on the ground. After rains, ascospores are shot out of numerous black fruiting bodies (ascomata) and are carried by air currents to susceptible plant tissues (CPC, 2003). In the presence of moisture, the ascospores germinate, and penetrate the plant tissues. These germinating ascospores may result in latent infections (*e.g., G. citricarpa*) or active secondary infections providing continuous infection (*e.g., G. bidwellii*) (CPC, 2003). Conidiomata produce hundreds of conidia that ooze out during wet weather. The splash of raindrops spreads these spores to other tissues (CPC, 2003). Eventually, the conidiomata are transformed into an overwintering stage (pycnosclerotia) giving rise to ascomata within which the ascospores are produced. The relative epidemiological importance of each of these spore types differs among *Guignardia* species (CPC, 2003).

The genus *Leptosphaeria* has about 100 members that are widespread throughout the world (Kirk *et al.*, 2001). Species occurring in China include *L. coniothyrium* (rose stem canker, raspberry cane blight), *L. maculans* (blackleg of crucifers), *L. nodorum* (glume blotch of various cereals), *L. salvinii* (stem rot of rice) and *L. schefflerae* (a newly named species causing disease in the ornamental foliage plant *Schefflera actinophylla* (CPC, 2003; Xi *et al.*, 2003). All of these species, except *L. schefflerae* also occur in the United States (Farr *et al.*, 1989). *Leptosphaeria* belongs to a group of soilborne fungi that cause root and lower stem rots of many vegetables, ornamentals, field crops and trees (Agrios, 1997). As a general rule, the root and stem rots caused by this group of fungi appear on the affected plant organs at first as water soaked areas that later turn brown to black. Lesions are sometimes covered by white fungal mycelium. The roots die quickly and the whole plant grows poorly or also dies. The fungi in this group are nonobligate parasites that live, grow and multiply as soil inhabitants, usually in association with dead organic matter (Agrios, 1997).

For *L. maculans*, one of the best studied species in the genus, ascospores are the most important form of primary inoculum and airborne dissemination is the most common dispersal mechanism while diseased stubble has been shown to be the main source of inoculum (CPC, 2003). Ascospore discharge is influenced by rain and release generally starts within 1 to a few hours after the onset of rain and ceases several hours after rain stops. Additionally, heavy dews or high humidity may be sufficient to initiate or sustain spore release. Ascospores can be dispersed up to several kilometers (CPC, 2003). The life-cycle comprises a sexual stage (*L. maculans*) producing ascospores and an asexual stage (the anamorph, *Phoma lingam*) which produces pycnidiospores. Pycnidiospores may be windborne or water splashed (Agrios, 1997) and are of uncertain epidemiological importance in the blackleg disease caused by *L. maculans* (CPC, 2003).

Numerous fungicidal controls have been identified for various *Leptosphaeria* diseases. Mancozeb is registered in the United States for control of *Leptosphaeria* brown spot in *Dieffenbachia* (Dragon, 2003). Fenarimol, Propicontzol, Iprodione, Thiophanate-methyl and Cyproconazole are all recommended for control of necrotic ringspot disease of turfgrass caused by *L. korrae* (AMPAC, 2001). Dichlofluanid and thiophanate-methyl substantially reduced the incidence of vascular lesions arising from raspberry cane blight (*L. coniothyrium*) (Williamson and. Hargreaves, 1976). Penaud *et al.*, (1999) recommended Eria (difenoconazole + carbendazime) to control blackleg disease caused by *L. maculans*.

The genus *Sphaerella* is now considered a synonym of *Mycosphaerella* (Gonsalves and Ferreira, 1994). The different species in the genus *Mycosphaerella* range in number from 500 to 1,000 (Streets, 1982). It is the largest genus in the Dothideaceae with the majority of species being saprobic (Agrios, 1997). However, many species are economically important plant pathogens. *Mycosphaerella* occurs on the leaves and stems of several hundred different host plants (Corlett, 1991) including cultivated and ornamental plants and forest trees (Corlett, 1991). *Mycosphaerella* spp. have been described to cause the following types of diseases: brown leafspot, ringspot, gummy stem blight, leafspot, ascochyta blight, stem-end rot, leaf splitting disease, yellow and black Sigatoka and black leaf streak (Ploetz, 2003).

Three spore structures are spermatia (produced in spermogonia), ascospores (produced in perithecia), and conidia of the *Cercospora*-type (produced in sporodochia) (Agrios, 1997). The fungi can spread to healthy hosts either as conidia or as ascospores. Spores germinate and penetrate the plant through the leaf stomata. Fungal fruiting bodies (spermagonia, sporodochia) then form. Conidia produced from sporodochia are released and disseminated; this enables the conidia to infect another host plant. Also, the spermatia can fertilize compatible sexual hyphae to form the perithecia where ascospores are produced. Like the conidia, these ascospores can then be released and disseminated to begin the infection process again (Agrios, 1997). Spores of different species are adapted to rain splash and/or wind dispersal (CPC, 2003).

Phellinus noxius was recorded only from tropical regions of the world, although it is found in Japan and Australia (New South Wales). *P. noxius* appears to be non host-specific attacking trees belonging to over 50 tropical genera (CPC, 2003). It is an opportunistic pathogen; the only restriction being its very slow growth rate which means it is unlikely to cause problems in annual crops (CPC, 2003). *P. noxius* is spread in two main ways. The first is by windborne spores which can infect freshly cut tree stumps or fresh wounds (Sujan and Pandey, 1989). The second is by root-to-root contact (Lewis and Arentz, 1988). Infected root pieces can remain viable for many years in the soil (CPC, 2003).

The leaves of an infected tree yellow and wilt and typical dieback symptoms result. Symptoms may develop slowly or the tree may wilt and become defoliated in only a few days. The most characteristic symptom of this disease is the brown encrustation covering the surface of the diseased roots. This consists of brown mycelium in which soil and small stones are firmly embedded (CPC, 2003). Field symptoms combined with the presence of encrustation are the most practical diagnostic features of this disease. Early detection of the pathogen before the typical wilt symptoms are visible is difficult. Methods include scraping away the soil around the collar and the main roots and looking for the distinctive mycelial sleeve. The most practical method in a plantation situation is to examine the roots of dead or dying trees looking for the mycelial encrustation (CPC, 2003).

Control measures depend on routine inspection and removal of diseased trees. Various fungicides have activity against the pathogen (Lim *et al*., 1990; Mappes and Hiepko, 1984).

Macrophoma ehretia belongs to a genus in which the spores are forcibly discharged from fruiting structures and then dispersed by wind and rain (Agrios, 1997; Pirone, 1978). *Macrophoma candollei*, a species found in the United States and similar to *Macrophoma ehretiae,* frequently colonizes boxwood leaves that die as a result of various root diseases or environmental stresses. This fungus produces numerous black fruiting bodies, seen as dark specks on dead leaves (Hansen, 2000; Malinoski *et al.,* 1995). It is a secondary colonizer of dead leaves and its presence indicates that the plant is stressed by some other factor. No controls for *Macrophoma candollei* are recommended; however, predisposing factors should be addressed (Hansen, 2000; Malinoski *et al.*, 1995).

Pestalosphaeria is a member of the ascomycete family Amphisphaeriaceae. *Pestalotiopsis* is an anamorph of the genus *Pestalosphaeria*. *Pestalotiopsis* species are parasitic or endophytic on living leaves and twigs but are often isolated from dead plant matter and even soil (Malloch, 1997).

Many *Pestalotia* species are primarily secondary pathogens. They are saprophytic on dead and dying tissues and is weakly parasitic infecting wounds under moist conditions. In the United States, *Pestalotia* causes *Pestalotiopsis* tip blight of conifers and gray leaf spot. Tips of conifer branches turn brown to grayish in color. Infected bark may be covered in fungal fruiting structures giving the tissue a black sooty appearance. Leaf spots tend to be tan to gray and are often the result of previous damage such as freeze injury, scorching or mechanical wounds (UGA, 2003a). *Pestalotia* leaf spots are seen on azalea, gardenia, holly, and rhododendron. *Pestalotia* usually causes damage on plants in the early spring following cold damage or other stress situations (Mullen and Jacobi, 2001). A species of *Pestalotia* is associated with a foliar blight in white pine nurseries. Mortality seldom occurs in the nursery, even on severely damaged seedlings. Control in white pine nurseries is accomplished using seedbed mulches that are free of fungus pathogens and protecting new foliage with a fungicide treatment (Affeltranger and Cordell, 2001). Dark, disc or cushion-shaped acervuli are formed under the plant epidermis which then splits open revealing the fruiting structures. Conidia are produced on short simple conidiophores within the acervulus (Affeltranger and Cordell, 2001).

Phomopsis is most commonly know for causing tip blight on junipers, but it also causes stem galls on woody ornamentals and stem cankers on numerous hardwoods and fruit trees. *Phomopsis* infection kills the current year's growth on juniper branches. Branch tips turn brown to gray and *Phomopsis* fruiting structures (pycnidia) can be seen on the killed growth. Stem cankers caused by *Phomopsis* may girdle and kill stems of numerous woody ornamentals and fruit and landscape trees. Cankers are often sunken, reddish in color with a distinct delineation between healthy and killed tissues. The fungus produces abundant fruiting structures along the killed tissue. Round, rough stem enlargements or galls may also be caused by *Phomopsis* (UGA, 2003b).

On conifers, *Phomopsis* species occasionally cause cankers and foliage blight. These fungi are common saprophytes occurring on dead tissues of living seedlings, fallen cones, and dead stems and needles. Small, black spherical pycnidia develop in cankers, producing spores that are spread by rain or irrigation water. The fungus' perfect state may occur on infected branches, releasing wind-borne spores that lead to within-nursery spread of the fungus. Several cultural practices are important in *Phomopsis* management. Thinning seedlings and decreasing watering reduces humidity. Removing diseased seedlings decreases the amount of inoculum for spread of the fungus. Top pruning, which creates infection courts, should be avoided and stressed seedlings (*e.g.*, from drought or frost) should be kept under careful surveillance as they are prone to infection. Under extreme conditions, applying a fungicide regularly to protect new growth has also proven to be effective (Anon., 2002).

Phomopsis blight has been a serious problem for more than 75 years in nurseries producing juniper seedlings and grafts. The only chemical currently registered for control of *Phomopsis* blight in the

United States is benomyl. This chemical applied at 7 to 10-day intervals, combined with a vigorous schedule of roguing infected seedlings over the same interval, will give excellent control of *Phomopsis* blight (Peterson and Hidges, 1982).

The genera *Pseudocercospora* and *Pseudocercosporella* are synanomorphs that share the same teleomorph (sexual form), *Mycosphaerella* (Kirk *et al.*, 2001). Spores are windborne (Ploetz, 2003). Both genera are widespread, with *Pseudocercospora* especially widespread in the tropics (Kirk *et al.*, 2001). Close adherence to a program of sanitation and eradication of infected leaves is the key to *Pseudocercospora* disease control. Complete removal of diseased leaves followed by regular inspection and removal of new diseased leaves will reduce inoculum levels (Farm Life, 2003).

Mitigation Measure	Evidence
(1) Plants must be established in approved unused growing media**.**	Fungal pathogens are generally introduced into the greenhouse via infested plant material or soil particles (Barry, 1996; Daughtrey *et al.*, 1995; McQuilken and Hopkins, 2001). Studies on APHIS-approved growing media found that pathogens are not present (Palm, 1994; Santacroce, 1991). The required use of APHIS approved growing media will prevent the introduction and / or spread of many fungal pathogens. *Leptosphaeria* belongs to a group of soilborne fungi. The fungi in this group are nonobligate parasites that live, grow and multiply as soil inhabitants, usually in association with dead organic matter (Agrios, 1997). The use of APHIS approved media negates this important inoculum source. Control of *Pestalotia* in white pine nurseries is accomplished by protecting new foliage with a fungicide treatment (Affeltranger and Cordell, 2001).
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Ball, 1998; Bodman *et al.*, 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Mizell and Short, 1999). Fungal pathogens are generally introduced into the greenhouse via infested plant material or soil particles (Barry, 1996; Daughtrey *et al.*, 1995; McQuilken and Hopkins, 2001). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999). A greenhouse management disease program begins with crop production in a greenhouse that is as free of pathogens as possible. Incoming plant material should be inspected for disease symptoms before placement into the production area. Diseased

Mitigation Measure	Evidence
	plants should be refused or isolated for pest control before placement into the production area (Barry, 1996). Access ensures compliance with APHIS requirements and serves as a deterrent by providing a mechanism for removal from the program if pests are found (Kahn and Mathur, 1999).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by reducing inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999; Van der Plank, 1963). A greenhouse management disease program begins with crop production in a greenhouse that is as free of pathogens as possible. Plant debris should be eliminated at the beginning and throughout the production of the crop. Incoming plant material should be inspected for disease symptoms before placement into the production area. Diseased plants should be refused or isolated for pest control before placement into the production area (Barry, 1996). The greenhouse enclosure provides a physical barrier to plants' exposure to fungal propagules from outside as the spores may be rain splashed (such as *Guignardia miribelii, Macrophoma ehretia, Leptosphaeria* and *Phomopsis*) or windborne (such as *Phellinus noxius, Leptosphaeria* or *Pseudocercospora ehretiae*) (Agrios, 1997; Barry, 1996; Peterson and Hidges, 1982; Pirone, 1978; Ploetz, 2003; Sujan and Pandey, 1989). Standard greenhouse sanitation, *e.g.*, removal of plant debris, cleaning and disinfection of tools and facilities, *etc.* are essential practices which are commonly recommended to prevent fungal infections (Agrios, 1997; Pirone, 1978; Barry, 1996). Close adherence to a program of sanitation and eradication of infected leaves is the key to *Pseudocercospora* disease control (Farm Life, 2003). Removal of diseased plants and debris, automatically closing greenhouse doors, disinfection of tools, removal of crop debris and other sanitation measures are all recommended to exclude fungi from pest free greenhouses (Roosjen *et al.*, 1999).
(5) Plants must be rooted and	This period of exclusion serves as a pre-shipment quarantine by

Mitigation Measure	Evidence
grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Complete removal of diseased leaves followed by regular inspection and removal of new diseased leaves will reduce inoculum levels of *Pseudocercospora* (Farm Life, 2003). Benomyl combined with a vigorous schedule of inspection and roguing infected seedlings over the same interval, will give excellent control of *Phomopsis* blight (Peterson and Hidges, 1982).
(7) Plants must be watered only with rainwater that has been boiled or pasteurized, with clean well water, or with potable water.	Good water quality is important for plant growth (Ball, 1998; Bodman *et al*., 1996; Jones and Benson, 2001), and the movement of some fungi in water is reduced or eliminated by the use of clean water sources (Roosjen *et al*., 1999).
(8) Plants must be rooted and grown in approved growing media on benches supported by legs and raised at least 46cm off the floor	See the discussion for APHIS approved media under item (1) above. Spores may be rain splashed (such as *Guignardia miribelii, Macrophoma ehretia* and *Phomopsis*). Yang and TeBeest, (1992), determined that 90 percent of the stem lesions on rice plants that resulted from rain splashed spores of the fungus *Colletotrichum gloeosporioides* were distributed to a height of 10 to 15cm..
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	These requirements ensure that soil-borne pests can not easily access plants (see (1) above). These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Regular inspections are recognized as an important part of a balanced pest management program (Roosjen *et al*., 1999). Provided the official inspections are adequately staffed by well-trained personnel, they can be quite effective in restricting the introduction of pathogens (Jarvis, 1992). A weekly routine of scouting plant material throughout all growing

Mitigation Measure	Evidence
	areas for symptoms or signs of disease can help detect problems when they are small and manageable (Barry, 1996).
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	Requiring the use of APHIS approved media helps ensure that soil-borne pests cannot easily access plants (see (1) above). Raised benches reduce plants' exposure to rain splashed spores from the ground (see 8 above). Other *Guignardia* species can be controlled using broad spectrum fungicides such as mancozeb or chlorothalanil (Nameth *et al.*, 2003; Ramsdell, 1994). We assume these fungicides will be similarly effective against *G. miribelii*. Numerous fungicidal controls have been identified for various *Leptosphaeria* diseases. Mancozeb is registered in the United States for control of *Leptosphaeria* brown spot in *Dieffenbachia* (Dragon, 2003). Fenarimol, Propicontzol, Iprodione, Thiophanate-methyl and Cyproconazole are all recommended for control of necrotic ringspot disease of turfgrass caused by *L. korrae* (AMPAC, 2001). Dichlofluanid and thiophanate-methyl substantially reduced the incidence of vascular lesions arising from raspberry cane blight (*L. coniothyrium*) (Williamson and Hargreaves, 1976). Penaud *et al.*, (1999) recommended Eria (difenoconazole + carbendazime) to control blackleg disease caused by *L. maculans*. Fungicide controls exist for *Mycosphaerella* species attacking a broad range of hosts including trees (Kessler and Swanson, 1985), fruit crops (Ploetz, 2003; Timmer and Johnston, 2003), floral crops (Monterey, 2003) and conifers (Sidebottom, 1995). We assume these fungicides will be similarly effective against *Sphaerella podocarpi*, *Pseudocercospora ehretia* and *Pseudocercosporella ehretia-thyrsiflora*. Control measures for *Phellinus noxius* depend on routine inspection and removal of diseased trees. Various fungicides have been found to have activity against the pathogen (Lim *et al.*, 1990; Mappes and Hiepko, 1984). Although controls for *Macrophoma candollei*, the *Buxus* fungus present in the United States, are not considered necessary (Hansen, 2000; Malinoski *et al.*, 1995), effective fungicides are

Mitigation Measure	Evidence
	available for *Macrophoma* diseases of fruit crops (Horton and Brannen, 2003), ornamentals (Clemson, 2000), conifers (Shurtleff, 2002) and woody ornamentals. We assume these fungicides will be similarly effective against *Macrophoma ehretiae*. Fungicides exist to control *Pestalotiopsis* on fruit crops (Ploetz, 2003). We assume these fungicides will be similarly effective against *Pestalosphaeria jinggangensis*. Benomyl is registered for control of *Phomopsis* blight on juniper in the United States. (Peterson and Hidges, 1982). We assume this and other broad spectrum fungicides will be similarly effective against *Phomopsis* sp.
(13) Water source must comply with 319.37-8(e) (v): (see Section B (7) above) whether cuttings are established inside or outside a greenhouse.	See discussion under (7) above.
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999). Regular inspections are recognized as an important part of a balanced pest management program (Roosjen *et al*., 1999). A weekly routine of scouting plant material throughout all growing areas for symptoms or signs of disease can help detect problems when they are small and manageable (Barry, 1996). Other *Guignardia* species can be controlled using broad spectrum fungicides such as mancozeb or chlorothalanil (Nameth *et al.*, 2003; Ramsdell, 1994). We assume these fungicides will be similarly effective against *G. miribelii*. Numerous fungicidal controls have been identified for various *Leptosphaeria* diseases. Mancozeb is registered in the United States for control of *Leptosphaeria* brown spot in *Dieffenbachia* (Dragon, 2003). Fenarimol, Propicontzol, Iprodione, Thiophanate-methyl and Cyproconazole are all recommended for control of necrotic ringspot disease of turfgrass caused by *L. korrae* (AMPAC, 2001). Dichlofluanid and thiophanate-methyl substantially reduced the incidence of vascular

Mitigation Measure	Evidence
	lesions arising from raspberry cane blight (*L. coniothyrium*) (Williamson and Hargreaves, 1976). Penaud *et al.*, (1999) recommended Eria (difenoconazole + carbendazime) to control blackleg disease caused by *L. maculans*. Fungicide controls exist for *Mycosphaerella* species attacking a broad range of hosts including trees (Kessler and Swanson, 1985), fruit crops (Ploetz, 2003; Timmer and Johnston, 2003), floral crops (Monterey, 2003) and conifers (Sidebottom, 1995). We assume these fungicides will be similarly effective against *Sphaerella podocarpi*, *Pseudocercospora ehretia* and *Pseudocercosporella ehretia-thyrsiflora*. Control measures for *Phellinus noxius* depend on routine inspection and removal of diseased trees. Various fungicides have been found to have activity against the pathogen (Lim *et al*., 1990; Mappes and Hiepko, 1984). Although no controls are considered necessary for *Macrophoma candollei*, the *Buxus* fungus present in the United States, (Hansen, 2000; Malinoski *et al.*, 1995), effective fungicides are available for *Macrophoma* diseases of fruit crops (Horton and Brannen, 2003), ornamentals (Clemson, 2000), conifers (Shurtleff, 2002) and woody ornamentals. We assume these fungicides will be similarly effective against *Macrophoma ehretiae*. Fungicides exist to control *Pestalotiopsis* on fruit crops (Ploetz, 2003). We assume these fungicides will be similarly effective against *Pestalosphaeria jinggangensis*. Benomyl is registered for control of *Phomopsis* blight on juniper in the United States. (Peterson and Hidges, 1982). We assume this and other broad spectrum fungicides will be similarly effective against *Phomopsis* sp.

Fungi: Mildews and Rusts

Aecidium sageretiae
Melampsora serissicola
Meliola buxicola

Phakospora ehretiae
Puccinia buxi
Uncinula ehretiae
Uredo ehretiae
Uredo garanbiensis

Rust fungi are highly specialized parasites that depend on living plants for growth and development. They cannot be cultured. Most have complex life cycles that include up to five different spore stages and two different hosts to complete their life cycle:

> Rust -colored pustules contain the dikaryiotic uredospores, which reproduce vegetatively and with the aid of the wind infect the primary host. In autumn, winter-resistant teleutospores form in black pustules. The two nuclei of the teleutospores fuse to form a diploid nucleus. In the spring they divide meiotically and form four haploid basidiospores. These pathogenic spores have two different mating types. The wind carries them to the alternate host. Here, too, an infection is recognizable through pustules, the pycnidium on the leaf upper side and the aecidium on the lower side of the leaves. Pycnidospores from opposite mating types fuse and form the aecidium on the leaf underside. The aecidiospores form in them. Carried by the wind the mature aecidiospores infect the primary host and the life cycle is completed (Alexopoulos *et al.*, 1996).

Depending on their need for an alternate host, rust fungi are classified as either heteroecious or autoecious. Heteroecious rusts need two different hosts in order to complete its life cycle. Autoecious rusts complete their life cycle on one host. It is helpful to know the life cycle of a rust to manage it. In the case of heteroecious rusts, the alternate host may be the initial source of spores. Primary host stock kept outdoors during the summer may become infected by airborne spores from the alternate host. Stock plants brought in from elsewhere may also be a source of the disease. For heteroecious rusts, elimination of the alternate host can be helpful (NEGFG, 2003). There is limited published information available about the life cycles of the rusts identified as attacking Chinese penjing and what, if any alternate hosts they may require. Information was therefore derived, by necessity, from the published literature on related species.

Fungicides registered for greenhouse control of rusts in the United States include: Daconil Weather Stik, Compass, Fore Flo XL, Heritage, Plantvax 75W, Strike 25 WP, Systhane WSB and Zyban WSB (NEGFG, 2003).

Melampsora is the type genus in the rust family Melampsoraceae. In the Midwest, premature defoliation of willows, poplars, aspens, and cottonwoods is often caused by three or four leaf rust fungi in the genus *Melampsora* that use coniferous tree species as alternate hosts (Babadoost, 1989). Small, yellow spots develop on the upper leaf surface of susceptible willows and poplars in early summer, especially on the lower branches. Bright, lemon-to-orange yellow, powdery pustules (or uredinia) form on the corresponding lower leaf surface (Figures 2 and 3). The pustules may be scattered on the leaves or be so crowded that the entire surface looks powdery and yellowish orange. The dusty pustules contain many thousands of microscopic spores (urediniospores). The spores are easily windborne to leaves in the upper branches and to nearby susceptible trees where infections occur in moist weather. Several generations of uredinia and urediniospores may be formed through the summer during humid or wet weather. By late summer to mid-autumn, the pustules turn dark brown to black and become crust-like. These dark pustules contain large numbers of thick-walled resting (teliospores) that overwinter in the fallen leaves (Babadoost, 1989).

Where *Melampsora* leaf rusts are a problem, they can be controlled using the following measures: collect and compost or burn fallen leaves to destroy infective spores; in areas where continuous and heavy infection occurs, new plantings of hosts should be located as far away from susceptible alternate hosts as possible; and, where leaf rusts are serious, plants can be sprayed two or more times, 7 to 21 days apart, starting a week or two before the rust normally appears (Babadoost, 1989).

Classification of the rusts in the order Uredinales is based on the characteristics of the teliospore. However when a teliospore is not available, rusts are assigned to form genera based on other characteristics. The form-genus *Aecidium* is the name given to the aecial stages that produce their aeciospores in a cup-like structure.

Meliola species cause black mildew diseases, especially in the tropics (Kirk *et al.*, 2001). Like the sooty molds that they closely resemble physically, the black mildews subsist primarily on the honeydew produced by insects (see mealybugs above). They produce velutinous black sooty films on leaves and petioles (Ploetz, 2003). While the sooty molds are saprohytes, the *Meliola* mildew fungi are obligate parasites that do invade plant tissues (Kirk *et al.*, 2001). Damage however, is only superficial and effective control can usually be achieved by reducing the insect infestations responsible for producing the honeydew (Ploetz, 2003).

There are approximately 75 species in the genus *Phakospora*, most occurring in the tropics (Kirk *et al.,* 2001). About eight species are known to occur in the United States including species attacking grasses, cherimoya, croton, cotton, jatropha, commelina and ziziphus (Farr *et al.*, 1989). Perhaps the best known species of *Phakospora* are *P. euvitis*, the cause of grape rust, and *P. pachyrhizi,* the cause of soybean rust. Their life cycle is similar to that described above for *Melampsora* although for some Phakospora species (*P. pachyrhizi*) pycnial and aecial stages have not been found (CPC, 2003).

Application of Bordeaux mixture, captafol, difolatan, prochloraz and polycarbamate were reported to significantly reduce *P. euvitis* incidence in a Delaware vineyard (CPC, 2003); benomyl and BDC were also reported to be effective. No single class of fungicides has emerged as uniquely effective in suppressing the soybean rust fungus (Bromfield, 1984). The application of formulations of zineb periodically throughout the growing season gives favorable control (Bromfield, 1984).

Puccinia buxi is a member of the Pucciniaceae, the largest family in the order Uredinales which also includes the Melampsoraceae discussed above. Members of *Puccinia* typically have a heteroecious life cycle (Alexopoulos *et al.*, 1996). Ash rust, caused by *P. sparaginioides* can cause problems in nurseries throughout North America where it is controlled by removal of the alternate grass host and fungicide applications applied at two-week intervals (Jones and Benson, 2001).

The genus *Uncinula* belongs to the family Erysipaceae in the order Erysiphales. The fungi belonging to the Erysiphales are obligate biotrophs that cause a major group of plant diseases commonly known as powdery mildews (Alexopoulos *et al.*, 1996). As the name implies, powdery mildew fungi usually produce a conspicuous crop of white spores on the foliage or in some cases, stems or flowers. On most hosts, the disease is easy to recognize but occasionally other diseases produce similar symptoms (NEGFG, 2003). Powdery mildew fungi behave somewhat differently than other plant pathogens. For example, powdery mildews do not need free water for spore germination; free water may actually kill spores and inhibit disease development. Powdery mildew is most prevalent under conditions of high humidity. The powdery mildew fungi are fairly host specific, meaning that they do not spread from rose to zinnia, for example. However, plants in the same family, may be susceptible to the same powdery mildew species. Like the black mildew fungus, *Meliola buxi*, powdery mildews only colonize the upper layer of plant cells, and for this reason, chemical eradication of infection is possible. Therefore, it is not necessary to use fungicides to prevent powdery mildew. Growers can wait until disease first occurs before applying fungicide. There are a number of different genera and species of powdery mildew fungi and some variation in fungicide effectiveness may be observed (NEGFG, 2003).

Fungicide rotations with fungicides from different classes are suggested to reduce resistance development. Sterol Inhibitors: fenarimol, triadimefon, myclobutanil, triflumizole; Benzimidazoles: thiophanate methyl; Coppers: copper hydroxide, copper pentahydrate; Strobilurins: trifloxystrobin, kresoxim-methyl, azoxystrobin; Benzonitrile: chlorothalonil; and, Dichlorobenzoate: piperalin are among the fungicides used to treat powdery mildews in the greenhouse (NEGFG, 2003).

Members of the genus *Uredo* include synonyms and anamorphs for a number of rust species: *e.g.*, white rust of crucifers (*Albugo candidans*); beet rust (*Uromyces beticola*); bean rust (*Uromyces appendiculatus*). The term Uredo is defined as one of the stages in the life history of certain rusts (Uredinales), regarded at one time as a distinct genus. It is a summer stage preceding the teleutospore, or winter stage (Webster's, 1998). It is also used as a form genus for rust fungi when only the uredinal stage is known.

Mitigation Measure	Evidence
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access	The use of clean mother stock is an essential component of ornamental plant production (Bodman *et al.*, 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999; Mizell and Short, 1999). Fungal pathogens are generally introduced into the greenhouse via infested plant material or soil particles (Barry, 1996; Daughtrey *et al.*, 1995; McQuilken and Hopkins, 2001). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999). Stock plants brought in from elsewhere may also be a source of rust diseases (NEGFG, 2003).

Mitigation Measure	Evidence
to his facility to make sure it complies with the regulations.	Access ensures compliance with APHIS requirements and serves as a deterrent by providing a mechanism for removal from the program if pests are found (Kahn and Mathur, 1999).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by reducing inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen *et al*., 1999). The culmination of all practices aimed at reducing the amount of inoculum and its dispersal is the formulation of a strict code of greenhouse hygiene. Destroying 90 percent of the inoculum has been calculated to reduce disease incidence from 62 percent to 9.2 percent (van der Plank, 1963). Standard greenhouse sanitation, *e.g.*, removal of plant debris, cleaning and disinfection of tools and facilities, *etc*. are essential practices which are commonly recommended to prevent fungal infections (Agrios, 1997; Pirone, 1978; Barry, 1996). The greenhouse enclosure provides a physical barrier to plants' exposure to fungal propagules from outside as the spores may be rain splashed or windborne (such as *Puccinia buxi*) (Agrios, 1997; Pirone, 1978; Barry, 1996). For heteroecious rusts, elimination of the alternate host can be helpful (NEGFG, 2003). Where *Melampsora* leaf rusts are a problem, the following measures help control the disease: collect and compost or burn fallen leaves to destroy infective spores; in areas where continuous and heavy infection occurs, new plantings of hosts should be located as far away from susceptible alternate hosts as possible (Babadoost, 1989). *Meliola* mildew damage is superficial and effective control can usually be achieved by reducing the insect infestations responsible for producing the honeydew (Ploetz, 2003). Rust problems in nurseries may be controlled by removal of the alternate host and fungicide applications applied at two-week intervals (Jones and Benson, 2001).

Mitigation Measure	Evidence
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen *et al*., 1999). Most rusts, as the name implies, produce obvious symptoms ranging from small, yellow spots on the upper leaf surface to pustules so crowded that the entire surface looks powdery and yellowish orange (NEGFG, 2003; Babadoost, 1989; CPC, 2003). *Meliola* species produce velutinous black sooty films on leaves and petioles (Ploetz, 2003). Powdery mildews, as the name implies, produce a conspicuous crop of white spores on the foliage or in some cases, stems or flowers. On most hosts, the disease is easy to recognize but occasionally other diseases produce similar symptoms (NEGFG, 2003). These obvious symptoms aid in the detection and identification of these fungi.
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999 Regular inspections are recognized as an important part of a balanced pest management program (Roosjen, *et al*., 1999). Most rusts, as the name implies, produce obvious symptoms ranging from small, yellow spots on the upper leaf surface to pustules so crowded that the entire surface looks powdery and yellowish orange (NEGFG, 2003; Babadoost, 1989; CPC, 2003). *Meliola* species produce velutinous black sooty films on leaves and petioles (Ploetz, 2003). Powdery mildews, as the name implies, produce a conspicuous crop of white spores on the foliage or in some cases, stems or flowers. On most hosts, the disease is easy to recognize but occasionally other diseases produce similar symptoms (NEGFG, 2003). These obvious symptoms aid in the detection and identification of these fungi.
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches	Fungicides registered for greenhouse control of rusts in the United States include: Daconil Weather Stik, Compass, Fore Flo XL, Heritage, Plantvax 75W, Strike 25 WP, Systhane WSB and Zyban WSB (NEGFG, 2003).

Mitigation Measure	Evidence
(46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	Effective control of *Meliola* can usually be achieved by reducing the insect infestations responsible for producing the honeydew (Ploetz, 2003). Control measures for honeydew producing homopterans are discussed above. Application of Bordeaux mixture, captafol, difolatan, prochloraz and polycarbamate were reported to significantly reduce *Phakospora* incidence in a Delaware vineyard (CPC, 2003); benomyl and BDC were also reported to be effective. The application of formulations of zineb periodically throughout the growing season gives favorable control of the *Phakospora* causing soybean rust (Bromfield, 1984). Sterol Inhibitors: fenarimol, triadimefon, myclobutanil, triflumizole; Benzimidazoles: thiophanate methyl; Coppers: copper hydroxide, copper pentahydrate; Strobilurins: trifloxystrobin, kresoxim-methyl, azoxystrobin; Benzonitrile: chlorothalonil; and, Dichlorobenzoate: piperalin are among the fungicides used to treat powdery mildews in the greenhouse (NEGFG, 2003).
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999). Regular inspections are recognized as an important part of a balanced pest management program (Roosjen, *et al*., 1999). See the discussion of symptoms in sections (5) and (10) above. See the discussion of chemical controls in section (12) above.

Nematodes
Tylenchorhynchus crassicaudatus
Tylenchorhynchus leviterminalis
Xiphinema brasiliense

The order Tylenchida is the largest and most economically important group of plant parasitic nematodes (Siddiqi, 1985). Two species identified by the penjing risk assessments (USDA, 2003a, 2003b, 2003c, 2003d and 2003e), *Tylenchorhynchus crassicaudatus* and *T. leviterminalis*, belong to this order. The members of the genus *Tylenchorhynchus*, or stunt nematodes (Bell 2003), are generally small (adults rarely greater than 1 mm; Evans *et al.*, 1993). They are migratory root ectoparasites and typically require large numbers to cause significant root damage (Evans *et al*., 1993).

The third species, *Xiphinema brasiliense*, is a member of the Order Dorylaimida. Members of the genus, known as dagger nematodes, are migratory ectoparasites (Ferris 2001) and tend to be associated with woody hosts (Evans, *et al*. 1993). The latter may be, in part, because populations are reduced by frequent tilling (Ferris, 2001), so are less common pests of annuals. They range in length from 1.5 to 5mm in length (Luc, *et al.*, 1990). Eggs are deposited singly in water films around soil particles and are not enclosed in an egg-mass. Males are rare in most species and are apparently unnecessary for reproduction (Ferris, 2001).

Mitigation Measure	Evidence
(1) Plants must be established in approved unused growing media**.**	Soilborne ectoparasitic plant nematodes are extremely rare in the components of planting media, which is thus considered to be much safer than soil (Santacroce, 1991).
(2) Articles must be grown in compliance with a written agreement for enforcement of this section …The plants must be developed from mother stock which has been inspected no more than sixty days before establishment of the plants. (3) Plants must be grown in compliance with a written … The grower must allow access to his facility to make sure it complies with the regulations.	The use of clean mother stock is an essential component of ornamental plant production (Bodman, *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999;; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Furthermore, APHIS concludes that ectoparasitic root nematodes are not transmitted by vegetative propagation of above-ground tissues. Access ensures compliance with APHIS requirements and serves as a deterrent by providing a mechanism for removal from the program if pests are found (Kahn and Mathur, 1999).
(4) Plants must be grown solely in a greenhouse in which sanitary procedures are employed to exclude plant pests and diseases. This includes cleaning and disinfection of tools and facilities and adequate measures to protect against plant pests … The greenhouse must be free of soil and sand. It must have screens on all vents and opening of not more than 0.6 mm. All entryways must be equipped with automatically closing doors.	Sanitation effectively controls or eliminates all types of pests directly by eliminating the pests, and indirectly by eliminating safe hiding places and reducing food sources and inoculum levels (Agrios, 1997; Bessin, 2001; Jones and Benson, 2001; Roosjen, *et al*., 1999; Van der Plank, 1963). Excluding contaminated soil or plants from the greenhouse is recommended to prevent nematodes from entering (Roosjen, *et al*. 1999).

Mitigation Measure	Evidence
(5) Plants must be rooted and grown in an active foliar state for at least six consecutive months before export. The greenhouse must be used solely for exports grown in compliance with 7 CFR § 319.37-8.	This period of exclusion serves as a pre-shipment quarantine by allowing materials destined for the United States to be segregated from other plants. Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999). Nematodes can be suspected based on the damage they cause to host plants. Members of the genus *Tylenchorhynchus* are commonly known as stunt nematodes due to the reduction in host vigor their feeding can cause (Bell, 2003). *Xiphinema* species feed along the root or on the root tip. Damage to the roots causes foliage to become stunted (Ferris, 2001).
(7) Plants must be watered only with rainwater that has been boiled or pasteurized, with clean well water, or with potable water.	Well-water is the preferred source for irrigation, since it is generally pathogen-free (Jones and Benson, 2001), while untreated pond or river water may carry disease organisms (Rideout, *et al*., 1994). Other sources, such as potable municipal water or boiled water are also expected to be pathogen free, although they may be more costly for the producer. Since nematodes and their eggs are present in soil (Ferris, 2001), eliminating soil contamination of water prevents nematode transmission.
(8) Plants must be rooted and grown in approved growing media on benches supported by legs and raised at least 46cm off the floor	A height of 46cm is the minimum needed to prevent spread of plant-parasitic nematodes, particularly, *Meloidogyne incognita,* from plant to plant via irrigation or rain water splash (Ko, *et al*., 1997). We assume that the passive water dispersal of other nematodes and fungal spores is similar to that of *M. incognita*, and that this control is effective against their spread as well. Furthermore, a bench height greater than 46 cm makes inspections easier to perform (Kessler, 1999; Roosjen *et al*., 1999), and improves regulatory compliance. (Ko *et al*., 1997).
(9) Plants must be stored and packed only in areas free of soil, earth and plant pests.	These requirements ensure that soil-borne pests, such as nematodes, can not access plants being prepared for shipping (see (1) above). These requirements reinforce the good sanitation practices outlined in (4) above.
(10) Plants must be inspected in the greenhouse and found free of evidence of plant pests and diseases …	Inspections during this interval allow detection, identification and elimination of all types of pests (Roosjen, *et al*., 1999 Regular inspections are recognized as an important part of a balanced pest management program (Roosjen, *et al*., 1999). Nematodes

Mitigation Measure	Evidence
	can be suspected based on the damage they cause to host plants. Members of the genus *Tylenchorhynchus* are commonly known as stunt nematodes due to the reduction in host vigor their feeding can cause (Bell, 2003). *Xiphinema* species feed along the root or on the root tip. Damage to the roots causes foliage to become stunted (Ferris, 2001).
(12) Cuttings may be established in a greenhouse in approved media or outside the greenhouse on raised benches (46 cm in height) in pots containing APHIS approved growing media. When plants are moved to the greenhouse they must be washed free of planting media and debris and dipped in a pesticide to control mites, insects, fungi and nematodes.	Requiring the use of APHIS approved media helps ensure that soil-borne pests cannot easily access plants (see (1) above). APHIS expects that restricting plants to pots prevents plant to plant nematode transmission in the very unlikely event that one plant becomes infected. The impact of raised benches is discussed above in item (8). Raising plants off the ground is expected to reduce the likelihood of nematode infestation even more outdoors than it does in the greenhouse. Because of the above measures, the likelihood of nematode infestation is negligible. However, as part of the systems approach, plants and their roots are washed free of media and debris. APHIS expects washing to reduce numbers of ectoparasitic nematodes such as *Tylenchorhynchus* (Evans *et al.*, 1993) and *Xiphinema* (Ferris, 2001). Furthermore, plants will also be dipped with nematicide. Hogan *et al.* (1983) reported significant reductions in nematode populations on *Buxus* when nematicides were applied to field soils. Similarly, Benson and Barker (1979) reported population reductions of 97 to 98 percent after soil applications of nematicides to *Buxus*. The Benson and Barker study examined control of *Meloidogyne* species, an endoparasitic genus living at least partially within the root, while the nematodes reported to attack the penjing species under consideration are ectoparasites whose population would be more exposed to washing and the pesticide dip. Both of the cited studies were made using soil applications as opposed to bare root dips as proposed here. Nematodes presumably would be less likely to escape treatment in a dip as compared to soil applications.
(13) Water source must comply with 319.37-8(e)(v) whether cuttings are established inside or outside a greenhouse.	This item requires that cuttings be watered using approved sources as described in item (7) from the time that they are established, either inside or outside of the greenhouse. See item (7) for evidence.

Mitigation Measure	Evidence
(14) Plants must grow for at least 6 months in the greenhouse. While in the greenhouse, plants must be treated with broad spectrum pesticides at least once every ten days or as needed for three months before shipping to maintain a pest-free condition.	This impact of the preshipment quarantine period is addressed in item (5) above. This requirement specifies an additional 2 months of exclusion, therefore increasing the time period in which pests of the considered penjing species can be detected. Evidence for the efficacy of nematicide treatments is provided in item (12) above.

H. Conclusions

The mitigations detailed above emphasize the use of pest–free sources of growing media and pest–free commodity proper. There are several mitigations aimed at ensuring that the pest–free status is maintained throughout the production process and along the transportation pathway. A series of inspections also are incorporated to assure quality control and phytosanitary rigor.

Based on their respective biological characteristics, methods of dispersal, ability to be detected, and evaluation of effectiveness of measures under APHIS oversight, APHIS finds that the safeguards of 7 CFR § 319.37-8(e) and the additional mitigations described here will result in the effective removal of the pests of concern identified by the risk assessments for the penjing plants imported from the People's Republic of China pathway.

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